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Glimpses of the Cosmos

A Mental Autobiography

By Lester F. Ward, LL.D.

Vol. I. Adolescence to Manhood Period, 1858-1871
Age, 16-30

Vol. II. Scientific Career Inaugurated

Vol. III. Dynamic Sociology

Vol. IV. Period, 1885-1893. Age, 44-52

GLIMPSES OF THE COSMOS

BY

LESTER F. WARD

COMPRISING HIS MINOR CONTRIBUTIONS
NOW REPUBLISHED, TOGETHER WITH
BIOGRAPHICAL AND HISTORICAL
SKETCHES OF ALL HIS WRITINGS

The writings by which one
can live are not the writings
which themselves live.—JOHN
STUART MILL.

GLIMPSSES OF THE COSMOS

BY
LESTER F. WARD

VOLUME IV
PERIOD, 1885-1893. AGE, 44-52

Marchez. L'humanité ne vit pas d'une
idée. Elle éteint, chaque soir, celle qui
l'aguidée.—LAMARTINE.

C'est de la femme, au fond, que
provient l'homme.—AUGUSTE COMTE.

G. P. PUTNAM'S SONS
NEW YORK AND LONDON
The Knickerbocker Press
1915

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The Knickerbocker Press, New York

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Presidential address on the Course of Biologic Evolution, showing that evolution is neither linear nor arborescent, but zigzag, or sympodial. Sympodial development, a universal principle. Transplantation of the vanguard of civilization.

Indem man . . . auf die bürgerliche Verfassung und deren Gesetze, und auf das Staatsverhältniss Acht hat, in so ferne beide durch das Gute, welches sie enthielten, eine Zeit lang dazu dienten, Völker emporzuheben und zu verherrlichen, durch das Fehlerhafte aber, das ihnen anhing, sie wiederum zu stürzen, so doch, dass immer ein Keim der Aufklärung übrig blieb, der, durch jede Revolution mehr entwickelt, eine folgende noch höhere Stufe der Verbesserung vorbereitete, so wird sich, wie ich glaube, ein Leitfaden entdecken, der . . . zur Erklärung des so verworrenen Spiels menschlicher Dinge . . . dienen kann.—IMMANUEL KANT.

Fundamental superiority and historical priority of the female to the male sex and of woman to man, scientifically demonstrated.

Die Mutter ist früher als der Sohn. Die Weiblichkeit steht an der Spitze, die männliche Gestaltung der Kraft tritt erst nach jener, in zweiter Linie, hervor. Das Weib ist das gegebene, der Mann wird. Von Anfang an ist die Erde, der mütterliche Grundstoff. Aus ihrem Mutterschosse geht alsdann die sichtbare Schöpfung hervor, und erst in dieser zeigt sich ein doppeltes getrenntes Geschlecht; erst in ihr tritt die männliche Bildung ans Tageslicht. Weib und Mann erscheinen also nicht gleichzeitig, sind nicht gleich geordnet. Das Weib geht voran, der Mann folgt; das Weib ist früher, der Mann steht zu ihr im Sohnesverhältniss; das Weib ist das Gegebene, der Mann das aus ihr erst Gewordene.—BACHOFEN.

Publishers' Note

IN bringing into print this fourth volume of Ward's *Glimpses of the Cosmos*, the publishers are glad to be authorized by the executor of Dr. Ward's estate to announce to the public that plans have now been matured for the completion of the set. As a result of the death of the author, it has been found necessary to omit certain portions of the manuscript in order to reduce the size of the set. The omissions consist of articles already in print and easily available and the places where they can be found are indicated.

It is the present expectation to complete the set in eight volumes. The successive volumes will now follow regularly and promptly until the issue of the eighth and final one. The text presented has had the advantage of the final revision of the author and is in the form in which he was prepared to present it to his readers.

NEW YORK, February 15, 1915.

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GLIMPSES OF THE COSMOS

Glimpses of the Cosmos

July-August, 1885—Ætat. 44.

195. Evolution in the Vegetable Kingdom

History.—Written in its present form with diagrams Dec. 7–9, 1884. The article consists substantially of the three papers that I read before the Biological Section of the A. A. A. S. at Philadelphia on September 8. The new title for the whole series was adopted Dec. 7, when I commenced rewriting it. I thought with that title it might be accepted by the *Popular Science Monthly*, and I sent it there as soon as finished, viz., on Dec. 9. They held it more than three months and returned it on March 26, 1885. Professor Cope, then editor of the *American Naturalist*, who, as presiding officer of the Section before which I read the papers, had asked me on Sept. 29, to let him have them for the *Naturalist*. Dr. Gray had spoken very highly of them in the introduction to his paper before the same Section and also at a special meeting of botanists the next day at the Academy of Sciences in Cope's presence. I would not give them to him at first, and published them in partial and imperfect forms in the *Botanical Gazette* (see supra, Vol. III, p. 378, No. 180) and in *Science* (see supra, Vol. III, p. 388, No. 183). But when the *Popular Science Monthly* declined the final revised draft, I concluded to let Cope have it. He was very glad to get it and brought it out in good shape in two numbers of the *Naturalist*.

The *American Naturalist*, Philadelphia, Vol. XIX, No. 7, July, 1885, pp. 637–644; No. 8, August, 1885, pp. 745–753.

October 9, 1885—Ætat. 44.

196. A Convenient System of River Nomenclature

History.—Written Sept. 9, 1885. The observations were made while on a geological excursion through Virginia in company with Prof. Wm. M. Fontaine and Mr. W. J. McGee. We were traveling south on the Telegraph Road and crossed all the rivers, Ny, Po, Ta, and followed down the Tapony to the mouth of the Matt, and to Milford Station on August 6, 1885.

Science, New York, Vol. VI, No. 140, October 9, 1885, pp. 321-322.

EVERY tyro in geography has learned that the Mattapony and Pamunkey are the two streams that flow into the head of the so-called York River, which is simply an estuary of Chesapeake Bay; but few, I imagine, have ever been told how the first of the above names is compounded, since its tributaries are too small to be named on ordinary school maps.

On approaching, a few weeks since, the sources of the Mattapony from the north I was a little surprised at hearing the inhabitants place the accent on the last syllable in pronouncing it. Presently, coming to a brisk little mill stream and inquiring its name, I was informed that it was the Ny River. Soon crossing a second of about the same size I learned that this was the Po. Still a third was passed not long after and this rejoiced in the name of Ta. Turning to the eastward soon after crossing the Ta and proceeding some distance down the course of the river system to below the union of all three of these tributaries and crossing back over the combined stream, this was found on inquiry to be the Tapony. At last the mouth of the Matt was

passed, below which only, the river is recognized as the *Mattapony*. Between the junction of the Ny and the Po and above the confluence of the Ta it is said to be known as the *Pony*, although this particular portion was not traversed and this name not heard spoken by the inhabitants. The system of nomenclature is therefore complete and symmetrical.

It is due to the people living among these streams to say that they all understand perfectly and fully appreciate this system of naming, and indeed seem proud of it and anxious to explain it to strangers. So extremely simple is it that even the negro work-hands use it with perfect accuracy.

It occurred to me that this case might furnish a valuable suggestion to geographical explorers who are constantly called upon to give names to unknown watercourses. If instead of assigning polysyllabic names to all streams, which must be learned by the public as so many independent facts, they would use monosyllabic names for the ultimate tributaries, capable of easy composition with one another, and then designate the successive trunks formed by these tributaries, by the compound word formed by their names, a rational system of nomenclature would result which would unite every river system practically under a single name and still leave not only every tributary but every part of the main stream with a distinctive appellation. I merely throw out the suggestion without attempting here to specify such practical limitations to the general principle as will naturally occur to geographers who might contemplate its actual adoption.

October 17, 1885—Ætat. 44.

197. [Meaning of the Word Nomadism]

History.—Remarks on the paper of Mr. Cyrus Thomas entitled: *Cherokees probably Mound-Builders*, read Feb. 5, 1884.

Transactions of the Anthropological Society of Washington, Vol. III, November 6, 1883—May 19, 1885, Washington, 1885, p. 29.

October 17, 1885—Ætat. 44.

198. Mind as a Social Factor.—Abstract

History.—This abstract was written Feb. 18, 1884. The paper was read before the Anthropological Society on the 19th. On the 21st, I took a copy of the abstract to the office of the

Washington Post and gave it to Mr. West, City Editor, who had it inserted on the 23d. The original I introduced into the *Transactions* of the Society.

The full history was given with the paper (*supra*, Vol. III, p. 361, No. 179).

Transactions of the Anthropological Society of Washington, Washington, 1885, Vol. III, pp. 31-32; the *Washington Post*, Washington, D. C., No. 2143, Feb. 23, 1884, p. 3.

October 17, 1885—Ætat. 44.

199. [Apparent Discontinuities in Biology]

History.—Remarks on the paper of Mr. H. H. Bates on *Discontinuities in Nature's Methods*, read March 18, 1884. [In the *Transactions* of the Society the meeting is said to have taken place on March 15th. This is an error. The Society always met on Tuesdays. March 15th was Saturday. The same mistake was made respecting the preceding meeting, which is put on March 1st, when it occurred on March 4th. Other dates in the volume seem to be correct.]

Ibid., pp. 53-54.

October 17, 1885—Ætat. 44.

200. [Social Forces]

History.—Remarks on the paper of Dr. J. M. Gregory on the *Elements of Modern Civilization*, read April 15, 1884. These remarks were written out by me with some care the following day and the footnotes appended.

Ibid., pp. 63-64.

October 17, 1885—Ætat. 44.

201. Moral and Material Progress Contrasted

History.—Written under the title, *Two Forms of Social Progress*, Dec. 18, 1884 to Feb. 4, 1885. Rewritten and title changed Feb. 5-16, 1885. Read before the Anthropological Society of Washington, Feb. 17, 1885, where it was discussed at length by many members (see the *Transactions* of the Society Vol. III, pp. 130-136). My remarks in reply were written out as there printed on May 5th, when the minutes came to me and I saw that they were not correctly reported. The volume appeared in October and I ordered 500 reprints of my paper and the discussion thereon, and I distributed it widely. No paper that I have ever published has attracted more attention than this one. I received a great many letters asking me for it, some from the most unexpected sources, as, for example, from the veteran geologist, James Hall. I continued to hear echoes from it for more than two years. When Dr. Alfred Russel Wallace visited this country in 1887 and we invited him to address the Society on Feb. 15, he opened his remarks with a very complimentary reference to this paper. It contains original ideas that were not expressed in *Dynamic Sociology*. Some of these I had entirely forgotten. For example, when I received from Professor Gumpłowicz an article of his from the *Revue des Revues* for Nov. 15, 1895, entitled *Actions on Phénomènes*, in which he maintained that the only scientific view of history was to look upon human actions simply as natural phenomena, I was forcibly struck by the idea and wrote him a congratulatory letter. Long after that in chancing to run through this paper I discovered the following remark: "But, great as these differences seem and are,

there is a point toward which they may be made, hypothetically at least, to converge. This point is where the human activities are conceived as natural phenomena" (p. 125). When asked to give one of the Brown University Extension lectures on Nov. 15, 1909, on *Intellectual Development*, which I had not time to prepare *de novo*, I made the lecture consist of my original paper on *Two Forms of Social Progress*, of which I still possess the manuscript, with an appropriate introduction, and all supposed that it was entirely new.

Ibid., pp. 121-130, 136.

ONE of the most obvious and frequently observed facts that lie upon the surface of modern society is the persistence of social evils in spite of the progress of discovery and invention brought about for the purpose of relieving them.

The actual removal of social evils constitutes moral progress; the discovery of principles and the invention of appliances calculated to remove them constitute material progress. It is these two forms of social progress which it is proposed to consider in this paper.

As to the degree to which moral progress has taken place and is taking place in society, there are wide differences of opinion. Some sanguine minds imagine it to be very rapid, but this is generally due to a confusion of unrelated phenomena. They either confound material with moral progress directly, or they confound the predominance of cherished religious beliefs with that of morality, or the establishment of favorite forms of government with that of justice and liberty. Others, and this is much the larger class, deny that any moral progress has ever taken place or is now taking place, and maintain, on the contrary, that there has been moral degeneracy, and that the world is growing constantly worse. In so far as these are merely influenced by the survival of a tradition very prevalent among early races they may, perhaps, be left out of the account. Many of them, however, disclaim such influence and base their convictions on the facts of history and the condition of society as it is. But such also must be set down as extremists, incapable of duly weighing the evidence from all sides of the question.

A highly respectable class, embracing many of the finest minds of the present period, see no hope except in the gradual change of the constitution of the human mind, to be brought about through hereditary influences and the slow developmental laws by which man has been at length raised above the brute. They

deny the power of intelligence to improve the moral condition of society, and regard the ethical faculty as entirely distinct from the intellectual. "It is," said Mr. Herbert Spencer to an American reporter, "essentially a question of character, and only in a secondary degree a question of knowledge. But for the universal delusion about education as a panacea for political evils, this would have been made sufficiently clear by the evidence daily disclosed in your papers." And in a private letter received after his return to England, relative to views which I had expressed, he re-asserts this doctrine, and says: "As you are probably aware and as, in fact, I said very emphatically when in America, I regard social progress as mainly a question of character and not of knowledge or enlightenment."

In the light of all these somewhat conflicting opinions, if we were to rest the case altogether upon authority, we should at least be compelled to admit that the real moral progress of the world has been extremely slow, and that it is imperceptible even in the highest stages of enlightenment. Such, too, seems to be the lesson of history and of observation. It is only when we contemplate long periods of history and contrast the present or the recent past with the remote past that an advance can be perceived in the moral condition of mankind. Yet, when such an historic parallax is once secured, the fact that moral progress actually has taken place is distinctly seen. To read the history of England and compare the acts committed a few centuries ago by men of our own race, with what any one can see would be done now under like circumstances, is sufficient to demonstrate that improvement has been going on in both individual and public morals. Making every possible allowance for all that is bad in the present social system, no one could probably be found candidly to maintain that it is inferior, from the moral point of view, to that of the middle ages or even of the sixteenth century. Modern kings, bad as they are, no longer put their sons to death to prevent them from usurping their thrones, and the sons of kings, however profligate they may be, do not seek to dethrone their fathers. When Rome was at its zenith, it was no more than every one expected that the great armies of Cæsar and Pompey, on their triumphal return from victorious fields, would turn their arms upon each other for the mastery of the empire. And I have heard those familiar with Roman history predict, at the time when the vast armies of Grant and Sherman, far outnumbering the Roman legions, were marching victoriously through different parts of the South, that the last grand struggle of the war would be between the Army of the Cumberland and that of the Potomac—forgetting that since the age of the Cæsars there had been moral progress sufficient to render both the leaders and the soldiers incapable of such an act.

Political opponents are no longer beheaded on the accession

of a new party to power; neither are they thrust into dungeons nor exiled, as formerly. Persecution for opinion's sake has practically ceased. Scientific men are no longer burned at the stake, like Bruno and Servetus, nor made to recant, like Galileo and Buffon. Witchcraft has dwindled into innocent palmistry, and heresy is only punished in a few backward communities by a mild form of social ostracism. Imprisonment for debt has been abolished, and the Fleet and the galleys are things of the past. Primogeniture and entail have disappeared from most codes of law, and trial by jury has been instituted in the most influential states. The slave trade has been suppressed wherever European powers have acquired supremacy, and slavery has been abolished in all the most enlightened countries. Vast public and private charities have been instituted, and societies for the prevention of cruelty to children and to animals receive the sanction of law. And finally a great moral crusade, with a display of far more zeal than knowledge, is being preached against the admitted evils of intemperance.

✓ There has, then, been some moral progress within the historic period, but, considering the amount of moral agitation, it has been slight.

It is the characteristic of moral progress that it takes place rhythmically. In the achievement of moral reforms there are always experienced partial and temporary failures, prolonged interruptions, serious reverses, and constantly recurring waves of reaction, so that at no time has it been possible for the candid observer to perceive that any certain advance was being made. The ground continually being lost is never appreciably less than the ground gained, and none but the ignorant, the blinded, or the oversanguine see much cause for congratulation. In the great ocean of moral action so nearly equal are the tidal ebbs and flows that only the stoical philosopher whose vision ranges back into the remotest past or forward unto the remotest future, with utter contempt for the transient present, can perceive the minute increments of secular change—much as the geologist, provided with his vast time-measures, perceives the changes that are slowly taking place on the coasts of continents washed by the tides and waves of the apparently changeless ocean of waters.

Such is moral progress in society. With it we may now compare, or rather contrast, the other form of social progress which we have distinguished as material.

Material progress results entirely from mental and manual labor laid out on invention and construction. Moral progress is a product of *feeling*, material progress one of *thought*; the action accompanying the former is called *conduct*, that accompanying the latter is called *labor*. Conduct is confined to the avoidance of interference with liberty of action in others. Labor is directed to the production and distribution of the objects of desire.

Moral action aims at the restraint or control of the forces of society, of human desires, prejudices, and passions. Invention and labor aim at the control and utilization of physical and mechanical forces, and of such vital processes as underlie pastoral and agricultural pursuits.

The contrast in the essential nature of these two classes of social phenomena is thus seen to be very wide, but it is not greater than is the difference in their mode of operating. We have seen that moral progress always takes place by rhythmic action, and that its secular slowness is not due to its own inherent sluggishness, but to the fact that only the algebraic sum of its many fluxes and refluxes can be counted. In material development nothing of the kind is found. Every step is a permanent gain. Every mechanical invention is an inalienable contribution to the material prosperity of society. If the particular device first produced becomes at length obsolete, as is usually the case, it is only because from it as a basis better devices, involving additional principles and doing more efficient service, have grown up. And such, in fact, is the nature of all inventions.

But the machine is only the material embodiment of intellectual conceptions, and it is these that lie at the foundation of all material progress. Indeed, much of this progress has consisted of such conceptions without any definite materialization. Of this class is all real knowledge of nature, only part of which can be directly applied to man's material amelioration. Every natural truth acquired proves advantageous, and the progress of pure science, like the progress of invention, has been steady though not uniform, never intermittent nor rhythmical. The misguided forces of feeling which underlie the fluctuating moral activities of society have often resisted the progress of science, have seriously checked it, sometimes apparently arrested it during long periods, but they have never succeeded in forcing it backwards. The same is true of art, especially of practical or useful art. This fact is strikingly exemplified in the interest attaching to the few alleged "lost arts," as though it were next to impossible for a single art to be wholly lost. And so it is. Every age has known all that was known by the age that preceded it and has added something to this. Every age has possessed all the arts of the age that preceded it, and has added something to them. And this in spite of the most prolonged moral reactions, such, for example, as that of the middle ages.

If we examine the arts, implements, utensils, and weapons of any of the lower tribes, as, for example, the Esquimaux, of the extreme north, we shall find that they represent a high degree of skill, a large amount of inventive thought, and a considerable real knowledge of the laws of nature and of physical forces. A comparison of many such tribes also shows that these devices represent, like those of the most enlightened peoples, a series of

steps in invention answering to our improvements. But a better implement is never abandoned for a poorer one, and here, as in the higher races, progress has been constant—always forward. ¶ We may therefore safely conclude that the present high state of material advancement in scientific nations is the result of a series of intellectual conceptions materially embodied in art, stretching back into that dim past when the club embodied the highest mechanical principles known to man. ¶

Such is material progress, and such are the essential particulars in which it so widely differs in nature and method from moral progress. But, great as these differences seem and are, there is a point toward which they may be made, hypothetically at least, to converge. This point is where the human activities are conceived as natural phenomena, and their control through the normal inventive process is contemplated as a true art. If the power to do this shall ever be attained, there is no reason why morals may not progress in the same manner and at the same rate as material civilization. The true interpreters of human history now understand that it is to material progress, *i. e.*, to science and art, that what moral progress has actually taken place is indirectly due. It is knowledge of the universe enlarging the mental horizon that has dispelled the bigotry of pre-scientific ages and thrown the mantle of charity over individual conduct and opinion. And it is the arts of intercommunication that have really civilized the modern world, as compared with the world before their introduction.

But since morals, from the point of view of social science, are concerned exclusively with the welfare of men, and since material progress, both physical and intellectual, is also directed exclusively toward this same end, the question naturally arises, why does not the welfare of men advance *pari passu* with the progress of science and art? As already remarked, no thoughtful person will maintain that it does so advance, some insisting that the two are wholly independent, and others claiming that the moral condition of society is degenerating in spite of the brilliant material civilization of these later times. After conceding all that is possible on the side of a real moral progress in society the case is bad enough, and the blunt comment of crude common sense naturally and properly is, of what use are science and art if they are incompetent to add anything to the general welfare of mankind? And to this question the response of the highest science is that if they cannot do this they are of *no* use. The welfare of mankind is the ultimate test of utility, and whatever fails to withstand that test stands condemned.

But admitting, as has already been done, that all the perceptible moral progress that has taken place has been due to that of intelligence in interaction with the practical arts which it necessarily creates, it may still be a question whether this trifling

result is really worth the Titanic efforts which this teeming age puts forth. The attempt to answer this question would probably be attended with insuperable difficulties and need not be made. It will be more profitable to consider the far more important one whether, in the nature of things, this admitted slight influence of material upon moral progress could, even theoretically, be so far increased as to render them somewhat proportional in amount.

Moral progress may be defined as embracing all those changes in man's social condition which actually enhance his general well-being; material progress may be defined as embracing those changes which give him power, if judiciously employed, to improve his condition, without implying such employment. If these definitions are correct, it is evident that all that is needed to make moral progress depend quantitatively upon material progress is to secure the judicious employment of the modifications of crude nature which are produced by human thought and action. Knowledge, ingenuity, skill, and industry need to be applied to moral ends and directed to the attainment of the social well-being. At present science and art are only potential factors in civilization. The need is that they be converted into actual factors. They are well nigh omnipotent in the accomplishment of anything toward which they can be once fairly directed. The difficulty is entirely that of securing for them the opportunity for free action. The power, for example, to produce a large quantity of a useful commodity may exist, but the conditions be wanting for placing the product in the hands of those who want it. This checks the production without affecting the producing power. That lies latent, and such latent power is simply wasted. Nor is it altogether a discrepancy between production and distribution. The power to distribute exists as well as the power to produce, but the conditions are wanting which are necessary to call that power into exercise. And this is the actual industrial state of society.

What is true of art is true of science. Intelligence, far more than necessity, is the mother of invention, and the influence of knowledge as a social factor, like that of wealth, is proportional to the extent of its distribution.

Society has always presented to the thoughtful student two great inequalities as the adequate explanation of nearly all its evils—inequality of knowledge and inequality of possession. Moral progress, in so far as it has taken place at all, has consisted in the slight diminution of one or both of these inequalities. This is always accomplished by the adoption of a better system of distribution. These two commodities, information and possession, differ in the essential particular that the latter is and the former is not destroyed in consumption. The existence of a supply of knowledge for distribution is therefore proved by the very fact of its inequality. But there is a sense in which the

supply of wealth for distribution is also practically unlimited. Production never ceases from having reached a limit to the power to produce. It always ceases from having exceeded the power of the community to consume. But the limit of consumption is in turn never that of the desire to consume; it is always that of the power to obtain. The power of both production and consumption is limited only by that of distribution—not the mechanical means of distribution, for these, too, are unlimited, but the conditions to the performance of the sociological function of distribution. Could the distribution of knowledge and of physical necessities go on at a rate at all proportional to their possible creation, the moral progress of society, *i. e.*, the increase in its aggregate well-being or enjoyment, would not only be as rapid, but would also be as uniform and steady as its material progress. If the knowledge now in possession of the few were in the possession of all, its benefits would be far more than proportional to its universality, since inequality itself often renders knowledge positively injurious. Although it be true that if the actual wealth of the world were equally distributed the share of each individual would be a very small fortune, yet if the limitations to possible distribution were removed production would so far increase that almost any desired portion might fall to each and all.

Wherein, then, consists this mysterious yet potent barrier to the distribution of wealth and wisdom: this practically prohibitory tariff upon the world's commerce in both thoughts and things?

The answer is rather deep than difficult. The two processes as they go on in society belong to antithetically opposite categories of social phenomena. We have in them the ultimate kernel of that broad contrast which has just been drawn between moral and material progress. It is the great distinction between natural and artificial processes, between genetic and teleologic activity, between growth and manufacture, between the method by which feeling works and that by which intellect works. The former is a method of direct effort, and fails in the great majority of cases to attain its end because of obstacles which are never taken into account. The latter is a method of indirect calculation by which the obstacles are foreseen, and in one way or another provided against before the advance is attempted. Hence it is always successful if the phenomena and laws to be dealt with are really understood. This is why science and art, as already stated, move ever forward, never backward. The discovery of truth on the one hand, and the invention of artificial appliances on the other, are always going on, multiplying the power of man to produce and distribute the objects of desire. Of the gain thus made nothing is ever lost. But when we come to the actual utilization of the products of discovery, invention, and handicraft, we find this under the control of the opposite class of forces.

The power to produce either knowledge or wealth is controlled by man, exercised when it can serve his purposes, checked or arrested when it no longer does this. But the power to possess—the ability to obtain the truth discovered or the commodity wrought—is controlled by natural laws and depends upon the thousand accidents of life—the conflicting wills of men, the passions of avarice and ambition, the vicissitudes of fortune, the uncertainties of climate and seasons, the circumstances of birth and social station, the interests and caprices of nations and rulers. Of what use is discovered truth to the millions whose minds it can never reach? Why produce useful commodities which those who need them are unable to obtain? For while all producers are also consumers, and nearly all consumers are at the same time producers, yet few can satisfy their wants, however capable they may be of producing an equivalent in value of other forms. Inventions in the practical arts by which the power is acquired to multiply the products of labor, instead of working the rapid amelioration of the laboring classes, actually injure their prospects by throwing skilled artisans out of employment; and instead of resulting in greatly increased production they do not appreciably affect production, but reduce the amount of labor to the disadvantage of the laborer. The plea of over-production in periods of financial depression is the sheerest mockery, since it is just at such times that the greatest want is felt. It may be true that more is produced than the consumers can obtain, but far less is produced at all times than they actually need and are able to render a full equivalent for. The eager manner in which every demand for laborers is responded to sufficiently proves this. It proves also that the industrial system is out of order, and that we live in a pathological state of society. The vast accumulations of goods at the mills avail nothing to the half-clad men and women who are shivering by thousands in the streets while vainly watching for an opportunity to earn the wherewithal to be clothed. The storehouse of grain held by the speculator against a rise in prices has no value to the famished communities who would gladly pay for it in value of some form.

Yet in all this the fault cannot fairly be said to lie with individuals nor with corporations, with manufacturer nor merchant, with producer nor consumer. These do but act the nature with which they are endowed. This defective circulation of industrial products is the result of the state of society. It is in one sense normal, since it is due to the operation of natural laws governing social phenomena. The enormous inequalities of both the classes named and the evils resulting, constituting the major part of the woes of mankind, are simply due to the fact that the agencies for distributing knowledge and wealth are *free* in the politico-economic sense, *i. e.*, not regulated nor controlled by intelligent foresight.

The contrast between moral and material progress is the contrast between Nature and Art. Nature is free. Art is caged. The forces of Nature play unbridled among themselves, until choked by their mutual friction, they are equilibrated and come to rest. Art commands them with tones of authority to pursue paths selected by intelligence and thus indefinitely to continue to exert their power. Under the dominion of Science, *i. e.*, under the intelligent control of physical forces, man's power to create the objects of desire and to send them where he will, is practically unlimited. But under the dominion of Nature, *i. e.*, under the free operation of the social forces, as yet beyond the reach of science, these objects of human necessity in seeking unaided their proper destination conflict perpetually in their passage, dashing against unseen obstructions, forcing themselves into inextricable entanglements, polarizing themselves around powerful centers of attraction, heaping themselves up in inaccessible "corners," or flying off on tangential lines to be lost forever.

This is what in modern phrase is very properly denominated the "waste of competition." But it is far more than the mere waste of the wealth produced. It is the paralysis of the strong hands of science and art as they coöperate with labor in the creation of value. It is the stubborn, the protracted resistance which the moral forces of society offer to its material as well as to its moral progress.

The statement of the problem is its theoretical solution, which can be nothing less than the conquest by science of the domain of the social as it has conquered that of the physical forces.

But alas! how wide is the difference between the theoretical and the practical solution of a problem to the bare statement of which the foremost thinkers of the age are as yet unwilling to listen.

The paper was discussed at length by Messrs. Powell, Welling, Thomas, Baker, Peters, Hart, and Ward. . . .

Mr. Ward, in reply to numerous inquiries and objections made during the discussion of the paper, explained that for the sake of brevity he had omitted any precise definition of the term Moral Progress as used in the paper. He said that the term was often employed in two quite distinct senses, and that much of the discussion had considered it in the other sense from that clearly implied in the paper. There is a subjective sense which relates to individual character and an objective sense which relates to collective well-being. The paper did not pretend to discuss the question whether human character had advanced, or how much it had advanced. It aimed only to consider the relation of material civilization to social well-being, the sole test of moral progress in this objective sense being the condition attained with respect to the enjoyment of life. This progress

might be either positive, consisting in an increase in the pleasures of life; or it might be negative, and consist in the reduction of the pains of life. In fact this negative progress has been by far the most observable, the chief improvement in man's condition thus far being some slight mitigation of the evils of existence. In view of this criterion of moral progress as measured by the degree of collective happiness, all that had been said respecting higher standards of taste in literature and social life was irrelevant to the discussion, since it simply confounded refinement with enjoyment, which are two entirely distinct things. Admitting that finer sensibilities are capable of higher enjoyment, this is far from proving that they necessarily enjoy more, for they are also capable of more acute suffering, and the whole question originally was whether material civilization prevents more of the latter than it occasions.

Mr. Ward in conclusion expressed surprise that Dr. Welling should have seemed to regard his paper at all in the light of a jeremiad. On the contrary, he tried to take such a view of the future as should be philosophic rather than either pessimistic or optimistic, but had sometimes been accused of expecting results that were not likely to be soon realized.

November 3, 1885—Ætat. 44.

202. An Example in Political Science

History.—The history of this paper is given down to June 5, 1884, under the title: *The Claims of Political Science* (see supra, Vol. III, p. 333, No. 173). It was originally part of the article submitted under that title, but was sent back to me because of lack of space for publication. After the return of this portion I filed it away, never expecting to publish it, but on Sept. 24, 1885, Dr. Edward Young, so long Chief of the U. S. Bureau of Statistics in which I was employed at the same time, but who was engaged in newspaper work on the New York *Daily Telegraph*, a protectionist sheet, asked me to contribute something to that journal. Desirous of accommodating him, but having no time to write on such subjects, I bethought myself of this article and offered it to him without charge. He gladly accepted it and it appeared in due time with all proper credit.

The Daily Telegraph, New York, Vol. I, No. 29, November 3, 1885, p. 4.

AS an illustration of the possibility of discussing current political topics in a strictly scientific way, let us briefly consider the leading question that now engrosses public attention in the United States—the tariff question.

The statesman confines his investigations to those questions that concern the welfare of the state. Humanitarian questions, though perhaps equally scientific, are outside of his specialty. The two chief concerns of the statesman are the support of the Government and the welfare of the people. For the former the necessary revenues must be raised in ways that are at once practicable and as equitable as possible. The second is a much more difficult task and involves the establishment and preserva-

tion of a strong, self-sustaining nation, the development of the natural resources of a country, the fostering of home manufactures, the exclusion of effeminating luxuries, the attraction of skilled labor and the diversification of industry (which renders dense population possible), the prevention of waste of energy involved in redundant transportation, and many similar objects which are collectively grouped under the general head of *protection*. Every nation feels the need of such protection and adopts some form of it. It is always accomplished by favoring in some way certain industries. All bounties, subsidies, subventions, imports, and exemptions belong to this class. Manufacturing and maritime nations, like England, protect their interests by bounties and subventions to ship owners. New countries with agricultural and mining resources protect theirs by levying duties on foreign imports. Most highly enlightened countries, such as England, France, the United States, etc., impose more or less prohibitive duties upon alcoholic liquors and other products supposed to exert a demoralizing influence upon the people.

These two questions are now before the statesmen and people of this country: How best to keep up the national revenues, and whether, or how far, to protect the national interests. Narrowed down to its simplest expression, the question is, whether or not to reduce the existing tariff. This question is of course too broad for discussion here. It undoubtedly admits, however, of scientific investigation. It would involve the study of the effects of past legislation from historical and statistical data in connection with the existing condition of the people and the national resources. It would, therefore, be complicated and difficult, but nevertheless such is the legitimate business of the statesman, and he should no more shirk it than the biologist should shirk the intricate problems involved in the study of organic life.

But there are certain general principles which should enter into such a detailed investigation, and these may be stated in a very brief space. As before, we will look at the question from the two distinct points of view—revenue and protection.

A tariff as a mode of raising revenue is, in fact, a tax paid by the consumer in proportion to the amount of the dutiable commodities consumed. Except where restricted to a very few selected articles which are consumed only by the wealthy, it constitutes, therefore, substantially an equal tax upon all, regardless of their ability to pay it. Of course, of most articles the wealthy will generally consume more than the poor, but the difference in the amount of consumption bears no due proportion to the difference in the amount of possession. That the revenues of a state should be chiefly derived from the actual wealth of the state seems clear. A tax upon the producing

consumer who has no actual wealth, but only potential wealth—labor—is both unjust to the person taxed and injurious to the state. It cripples the laborer and reduces his wealth-producing capacity. There is only one form of raising revenue more objectionable than the revenue tariff, and that is the simple poll tax, which is so unpopular that it is now scarcely ever resorted to. It is clear, then, that the raising of revenue could never be candidly urged as an excuse for a tariff, except with a people so ignorant of political science and so hostile to the revenue officers that it was both possible and necessary to deceive them in this way into supposing that they really were not paying any taxes. And the people would do well to reflect that those who advocate this form of revenue do but virtually class them in this status of barbarism.

If, then, a tariff cannot be scientifically defended as a mode of raising revenue, can it be scientifically defended as a form of protection? Undoubtedly there are cases in which it can; but, as we have already seen, the advisability of resorting to any form of protection, as well as the nature and degree of such protection, must depend upon the circumstances of each case, or, more generally, must depend upon whether such a measure will produce more benefit than injury in the state. This much at least is clear, that if a tariff is urged it should be openly avowed that it is needed for protection. In an enlightened state, where the people are supposed to know that human activities are subject to uniform laws, capable, like other natural laws, of being discovered and utilized, no true statesman will shrink from a frank avowal of the true object for which any measure is advocated. Failure to do this, so frequent in modern politics, is, like the other case just referred to, virtually to deny to the people the civilized status which is openly claimed for them.

See, then, the conclusions at which we have arrived from a strictly scientific study of this important national problem:

1. That a "tariff for revenue" is one of the most unjust and impolitic forms of raising revenue.

2. That if a tariff can be justified at all, it must be expressly for *protection*.

3. That the advisability of a tariff for protection is not a general but a specific problem, and must be decided upon the merits of each particular case.

4. That this specific problem admits of strictly scientific investigation and settlement, which, though laborious and difficult, is the proper business of those who have chosen politics as their specialty.

These conclusions would probably as little suit the one as the other of the existing political parties, and would doubtless be regarded by both as an attempt to conciliate, which they are not, but merely to treat the question fundamentally.

Even if the conclusions should prove incorrect, as is liable to be the case in the discussion of any involved scientific question, this would no more prove that political science cannot be discussed as such than the errors of mathematicians or astronomers prove that mathematics and astronomy are not legitimate sciences.

December 13, 1885—Ætat. 44.

203. A National University

History.—Written Dec. 13, 1885. The editorial comments that follow my article in brackets seem to me to be very weak. The great State Universities that have grown up largely since that date have completely belied the statements there made. I mailed a marked copy of the number of *Science* containing it to Secretary Lamar on Dec. 21st.

Science, New York, Vol. VI, No. 150, December 18, 1885, p. 539.

THE strictures in *Science* (vi, 509) upon the recommendation of Secretary Lamar, that a national university be established in Washington, seem to me to be based upon a narrow view of the subject, and to be easily answered. The fact that the project has been opposed by the able president of one of the leading endowed colleges, who would be least disposed to look with favor upon any rival institution, cannot justly be urged as an argument against it, and that a senate committee should have been found indifferent to it in 1872 has no bearing on its merits.

The claim that there is "a fatal defect in any congressional bill to establish a university, so long as the principles of appointment to United States offices, and the tenure of those offices, remain what they now are," cannot be sustained in the face of the excellent and permanent scientific bureaus that have latterly grown up under the government and to which the secretary refers. The officers of these bureaus have been selected with special reference to their fitness, as is proved by the results; and they have almost, without exception, held office continuously through several administrations, including the recent reversal of parties. No such narrow policy as that of territorial representation has governed these appointments, the government having exercised

its right to select from the entire country, and secure the best talent.

But permanent tenure of office is by no means secured in private institutions. Even the highest undergo changes without detriment. Examples here would be superfluous. The government should surely have the same right that these have to improve the quality of its staff of officers. This objection, therefore, seems purely imaginary.

The territorial distribution of scholarships, on the other hand, ought to have nothing objectionable about it. It strikes me as altogether proper. The few students that can at best be instructed in any one institution, however large, are but a small fraction of the number who desire and will receive advanced instruction in the whole country; and it seems right that these few should, as nearly as practicable, represent the whole country territorially. Neither does there seem any inherent evil in permitting the national representatives to control this trifling patronage.

But a true university is not a mere school for the training of great numbers of young people. It is an institution in which the most perfect appliances for original research may be brought together; and where a few who are able and willing to avail themselves of them may have an opportunity to do so. The tenor of the secretary's report clearly shows that this is what he contemplated by a national university. He regards the existing scientific bureaus of the government, with all their apparatus and appliances, as the "foundation" upon which to erect a university as a "superstructure," thus making it a positive aid to the necessary research that the government must carry on. The whole would thus become a great American institute, analogous in some respects to the Institute of France.

Finally, the assumption, that the establishment of such an institution would "be acting on un-American principles," is, I think, also untenable. It would seem at the outset that a project that found favor in the eyes of "Washington, Adams, Jefferson, and Madison," could scarcely be regarded as "un-American." Is it, then, implied that schemes of public instruction are generally un-American? Certainly no other country in the world possesses any such system of public schools as the United States, and perhaps no American institution is more popular than our educational system. Whether sound or unsound, popular or state education is at least a thoroughly American idea, and the tendency is constantly to extend it to the higher branches of learning; as, witness the "grammar schools" of most cities, and the numerous state universities. It is true that this work is chiefly conducted by states and municipalities, as the natural way under a government constituted as ours is; but for a long time there has also existed a national "bureau of edu-

cation" at the seat of government, designed to aid and advise, rather than to control the entire system.

Neither can it be considered un-American for the government to encourage and actively prosecute scientific researches. No government in the world is doing so much in this line to-day as the United States, and *Science* stands in an excellent position to know the extent and quality of our government scientific work as well as the practical results which it is producing. In this respect we are becoming the envy of European nations, and they are just now beginning to learn from us that it is sound national policy.

A national university or institute of the kind intimated in Secretary Lamar's report would be thoroughly American in its conception and aims, and would fittingly crown the educational system of the country. Its organization should, and probably would, be largely intrusted to the National academy of sciences, whose advice in scientific matters the government is legally entitled to ask. On the contrary, the objections raised in *Science* seem to reflect the views of a now waning English school of economists, who continually cry "let alone" to every thing the government undertakes.

LESTER F. WARD.

[When a young man enters the service of any of our half-dozen leading colleges, he does so with the knowledge, that, as soon as he has proved himself a valuable member of the body of teachers, he will be given a position with a tenure of office through good behavior, and with a fair salary considering this permanency. In any university established by congress, not only would permanence of tenure be out of the question, but the efficiency will be affected and the very life of the institution threatened each year by the vacillating policy which any legislative body will necessarily pursue with regard to the sustaining appropriations. Whenever this country is ready for an American "institute," it will probably be an outgrowth of the National academy, the value of which is as yet not appreciated. Let us go slowly. It must be remembered that the principal advocates of the importance of governmental guidance of human affairs are residents of a country in which no other initiative force has been known.—ED.]

December (?), 1885—Ætat. 44.

204. Administrative Report for the Year Ending June 30, 1883

History.—Written June 20, 1883.

Fourth Annual Report of the United States Geological Survey, 1882-83,
Washington, D. C., 1884, pp. 50-51.

December (?), 1885—Ætat. 44.

205. Report of the Curator of the Depart- ment of Fossil Plants of the U. S. National Museum for the Year 1884

History.—Written January 4-5, 1885.

Annual Report of the Board of Regents of the Smithsonian Institution for the
year 1884, Washington, D. C., 1885, pp. 219-220

December (?), 1885—Ætat. 44.

206. Bibliography for 1884

History.—Written March 6-7, 1885.

Ibid., pp. 368-369.

On Mesozoic Dicotyledons.

(Amer. Journ. Sci., 3d series, vol. xxvii, April, 1884, pp. 292-303; Annals and Magazine of Nat. Hist. (London), 5th series, vol. xiii, May, 1884, pp. 383-396.)

An historical review, with numerous bibliographical citations, of the discovery of dicotyledonous plants in the Cretaceous

formation, and an attempt to correlate the various horizons and localities where found; also an enumeration of the species from each horizon. Concluding reflections upon the probable Jurassic origin of the subclass Dicotyledons.

List of plants Added to the flora of Washington and vicinity, from April 1, 1882, to April 1, 1884.

(To be published in Proc. Biol. Soc. of Wash., vol. 2.)

Printed as a separate, April 10, 1884.

This is a continuation of the general catalogue as published in Bulletin No. 22, U. S. National Museum (guide to the Flora of Washington and vicinity), and conforms in arrangement, type, etc., as nearly as possible, with that publication.

Caulinites and Zamiostrabus.

(Science, III (No. 65, May 2, 1884), pp. 532-533.)

Reply to a letter by Mr. Joseph F. James in a previous number of Science, criticising Mr. Lesquereux's figures of these fossil plants in his "Tertiary Flora."

The claims of political science.

(Science, III (No. 72, June 20, 1884), p. 748.)

A brief note contrasting the treatment of political phenomena by scientific men with that of other departments of natural phenomena, and maintaining their essential homogeneity.

The Upper Missouri River system. (Illustrated.)

(Popular Science Monthly, xxv (No. 149, Sept., 1884), pp. 594-605.)

A description of the process by which the Upper Missouri and Yellowstone Rivers excavate and transform their valleys, based upon personal observations chiefly made while descending the Missouri in an open boat, from Fort Benton to Bismarck, in August and September, 1883.

Irrigation in the Upper Missouri and Yellowstone Valleys.

(Science, IV (No. 82, Aug. 29, 1884), pp. 166-168.)

In this article the practicability and importance of irrigating the valleys of these rivers is pointed out, and the advantage of making it a national enterprise to be conducted by the Government is considered.

Sweet Cicely as a bur.

(Bull. of the Torrey Botanical Club, New York, XI, August, 1884, pp. 92-93.)

A note pointing out that seeds of *Osmorrhiza longistylis* are adapted to being distributed by animals in the manner of burs.

Mind as a social factor.

(Mind (London), IX, October, 1884, pp. 563-573.)

This paper was read before the Anthropological Society of Washington, February 19, 1884, as the vice-presidential address for the Sociological Section. It was also read before the Metaphysical Club of Johns Hopkins University, April 22, 1884. It is an attempt to show that psychic phenomena, as produced

by beings with a highly-developed brain, have constituted a class so far superior to all other forms of activity, that they must be treated by the sociologist as distinct and not regarded as identical with the physical forces of inanimate nature, as is practically done in the current *laissez faire* philosophy.

The fossil flora of the globe.

(Botanical Gazette, iv, October and November, 1884, pp. 169-174.)

An abstract of three papers on this subject read September 8, 1884, before the Biological Section of the American Association for the Advancement of Science at Philadelphia. The subject is treated from the historical, geological, and botanical stand-points, and a tabular exhibit of the numerical status of vegetable paleontology is appended.

February, 1886—Ætat. 44.

207. Administrative Report for the year Ending June 30, 1884

History.—Written June 29 to July 2, 1884. The special interest of this report is that it contains the prospectus of my proposed Compendium of Paleobotany (see *supra*, Vol. III, No. 142, p. 129).

Fifth Annual Report of the U. S. Geological Survey, 1883-84, Washington, 1885, pp. 55-59.

February, 1886—Ætat. 44.

208. Sketch of Paleobotany

History.—Written March 12 to August 4, 1884. This monograph was the first official contribution to the proposed *Compendium of Paleobotany* (see supra, Vol. III, No. 142, p. 129), but the data had been used before in a number of unofficial papers and in my lecture on *Plant Life of the Globe, Past and Present* (see supra, Vol. III, Nos. 142, 180, 183, 192-194, pp. 129, 378, 388, 427-434; Vol. IV, No. 195, p. 1). All that had been said before and much more was embodied in this paper. The greater part of my work for the Geological Survey when not in the field had been devoted to one kind or another of research bearing on this result—the classification of the collections, begun in February, 1882, the accumulation of the literature of paleobotany,—the extent of which is attested by the footnotes,—the cataloguing and compiling of the materials contained in many books, on which quite a large force was engaged under my direction, and the reduction of all this to a system.

On February 26, 1884, the Director of the U. S. Geological Survey, Maj. J. W. Powell, and the chief clerk, Mr. J. C. Pilling, invited me to contribute a paper to the forthcoming *Report of the Survey*. I told them that I thought the Compendium work had reached a stage at which I could prepare an *Introduction* to that work. On the 28, I drew up a synopsis of the principal heads of such a memoir. I reflected on the subject and brought the data together, and on March 12, I commenced writing the preliminary part. What title I first gave it I do not know. It was changed, and the manuscript is not preserved. My notes often refer to it as the *Introduction to the Compendium of Paleobotany*. The historical review was begun on April 18, and the biographical part was finished on May 8. The sketch

of the early history of the science was commenced on May 9, and completed on July 22. I stopped with the year 1850, because any attempt to review the more recent literature would require more time and space than I could give to it. The tables and diagrams had long been prepared, as seen by the unofficial papers above referred to. They had only to be introduced in their proper places. The manuscript was completed on August 4, and I took it to the Director to discuss it with him. Whatever my title was, he said it was too long, and proposed to call it simply a *Sketch of Paleobotany*. I was very willing to do so.

After the paper went in I continued to work on the statistical tables and made improvements in them which I wished to introduce. The reference to Martin Luther on page 391 was added in the proof. I had a long search, first for the book, which I found in the library of Dr. Butler, pastor of the Lutheran church, and then for the passage, which, when found, I copied out of the book on Sept. 15. The proof reading was completed in September, but the volume did not appear till February, 1886. My reprints were sent me on March 6, 1886. I distributed them pretty freely both in this country and abroad, and received many letters, mostly congratulatory, but some critical, as, *e. g.*, that from Mr. Jules Marcou, who thought I did not do justice to the French paleobotanists. Dr. Andrew D. White refers a number of times in his *Warfare of Science* to my treatment of the history of geology. Sir William Dawson in his *Geological History of Plants* reproduced the diagrams 2 and 3 by placing one over the other, which brings out the result very clearly.

Ibid., pp. 357-469, pls. lvi-lviii.

March (?), 1886—*Ætat.* 44.

209. [Effect of Winds on the Diversion of Water Courses]

History.—Remarks on the paper of Mr. G. K. Gilbert on the *Diversion of Water Courses by the Rotation of the Earth*, read March 15, 1884.

Bulletin of the Philosophical Society of Washington, Washington, Vol. VII, 1885, p. 23.

March (?), 1886—*Ætat.* 44.

210. [Indians as Observers]

History.—Remarks on the paper of Dr. Washington Matthews on *Natural Naturalists*, read Oct. 25, 1884.

Ibid., p. 74.

March 23, 1886—*Ætat.* 44.

211. Notes on the Flora of Eastern Virginia

History.—The excursion was made from July 27 to Aug. 31, 1885, with Prof. Wm. M. Fontaine of the University of Virginia and Mr. W. J. McGee of the U. S. Geological Survey. We did not camp, but depended upon the inhabitants. It was a geological reconnoissance and botanical observations were entirely secondary. Scarcely any plants were collected. The writing up of my botanical notes was made mere pastime and occupied me from Sept. 7, till Oct. 23, when I had them in such shape that I could venture to send them to the *Botanical Gazette*.

Botanical Gazette, Crawfordsville, Indiana, Vol. XI, No. 2, February, 1886, pp. 32-38.

March 28, 1886—Ætat. 44.

212. Moral and Material Progress Contrasted.—Abstract

History.—Written Feb. 13, 1886, at the request of Mr. Leech of the Smithsonian Institution. Mr. Leech was also probably responsible for the abstract of the same paper which appeared in the Smithsonian Report for 1885, Part I, pp. 843-844.

The Capital, Washington, D. C., Vol. XVI, No. 6, March 28, 1886, p. 4.

AMONG the recent contributions to science made by Washington men, and which possess a popular character, the paper of Mr. Lester F. Ward on "Moral and Material Progress Contrasted," read before the Anthropological Society, has attracted unusual attention. The views expressed in it are novel and refreshing, and touch upon a class of subjects that are just now coming into the foreground of public discussion among the best informed writers and thinkers. Mr. Ward, as many of our readers are aware, is the author of a large work on social science entitled "Dynamic Sociology," which has attracted the attention of the foremost philosophers of this country and England, and has led to a correspondence with Mr. Herbert Spencer, from certain of whose views Mr. Ward strongly dissents. These opposing arguments are presented in this paper, and the position taken in Mr. Ward's work is enforced in clear and strong language. He shows that whereas moral progress has always fluctuated, and the advances made have been lost in great waves of reaction, so that the total gain from the immemorial past has been very slight, material progress, on the contrary, has been uniform and steady, and nothing gained here has ever been lost. This has been brought about by the steady improvement and extension of the practical arts of life through scientific discovery and mechanical invention. This is due to the concentration of intellectual power upon the problems of practical life as they

present themselves to individual minds. It results in our brilliant material civilization, of which we are justly proud. But the true philosopher sees that all this power to relieve want has not succeeded in greatly relieving it. The ease with which the conditions to comfort and enjoyment are created does not prevent as large a proportion as ever of mankind from being debarred from these conditions. By moral progress Mr. Ward means the general extension of these conditions to the masses of the people, and this material progress—such as has thus far taken place—does not secure.

How this great *desideratum* can be attained and moral progress be made to take place *pari passu* with material progress Mr. Ward here very briefly but clearly points out. The subject is too large for so short a paper, and those who wish to see it fully expanded may find it in the work already named. In one word the remedy consists in applying to social and political affairs the same principles that prevail in individual affairs and by which the arts of life are perfected and multiplied. Here natural laws are comprehended and utilized for man's advantage by intelligent action. Nothing similar is seen in the higher sphere of social and political existence. Here unregulated nature holds sway. Before there can be improvement society must act as individuals act now; must manifest conscious intelligence in the positive pursuit of social well-being.

May, 1886—Ætat. 44.

213. On the Determination of Fossil Dicotyledonous Leaves

History.—Written March 11-15, 1886. On the seventh of August I received a long letter from Dr. Nathorst, discussing the whole subject and answering some of my objections to his proposed method. It was very friendly and respectful, and our relations have always remained cordial.

The American Journal of Science, New Haven, Third Series, Vol. XXXI
[Whole number CXXXI], No. 185, May, 1886, pp. 370-375.

December, 1886—Ætat. 45.

214. Broadening the Way to Success

History.—Written in its present form Sept. 25 to Oct. 7, 1886. As this is much condensed from a lecture that I had written long before, I will here give the full history of that lecture. On Nov. 17, 1885, I commenced writing an article on *Heredity and Opportunity*. I had so much else to do that I made small progress with it, and it lay on the unfinished list all winter. In the spring of 1886 I was designated, among others, by the Joint Lecture Committee of the Anthropological and Biological Societies of Washington to deliver one of the "Saturday Lectures," and having nothing else suitable, I decided to finish that article and use it as my lecture. It was finished on March 24. The program of lectures was issued about the first of April, and mine was to be given May 1. I received a letter from Mr. Justus O. Woods, Secretary of the Social Science Institute of New York, dated April 17, inviting me to come and give the lecture before that body. The lecture was delivered in Washington as announced, on May 1, and on the fifth, I sent a copy of it to Mr. Woods to make any use of it that he saw fit. On June 10, it was read before the Institute by one of the members, occupying the entire evening, and the next meeting, on June 26, was wholly devoted to its discussion. It aroused great interest, and there was considerable correspondence in relation to it. With my permission it was offered to several magazines, but it was too long for an ordinary magazine article. Mr. L. S. Metcalf, Editor of the *Forum*, agreed to publish it if I would condense it to 4,200 words, or 11 pages of the *Forum*. This I consented to do. I had continued to call the article *Heredity and Opportunity*, but Mr. Metcalf wished a more attractive title and proposed several in letters, and I sent several to choose from. None

of these, however, was satisfactory, and at the last moment of going to press, viz., on Nov. 1, I received a telegram from him proposing the one that the magazine article bears, which of course I accepted.

So much for the article, but the lecture has a more varied history. Early in 1896 the teachers in the colored schools of Washington, some of whom had heard it when it was delivered at the U. S. National Museum nearly ten years before, and among whom it had been much discussed, invited me to repeat it before them, and arrangements were made to that end. I consented, and it was delivered on Feb. 14. They seemed to see in it much hope for their race. Prof. W. B. Powell, Superintendent of the Public Schools, Mr. G. F. Cook, Superintendent of the Colored Schools, ex-Senator Bruce, and several other prominent persons were present.

In 1897 I gave two courses on Sociology in the summer school of the University of Chicago, and besides the regular class lectures I was asked to give several public lectures in the evening. I made this the last of the series and delivered it on Sept. 8, concluding my work there for the season. At the close of this lecture one of my students arose and addressed me in a neat speech, and presented me with a beautiful gold-headed cane as a testimonial from my class. I still possess it, though happily I have never been obliged to use it. On this occasion I changed the title to *Nature and Nurture*, Galton's "convenient jingle of words"*, and it was so announced in the *University Record* for Aug. 27 and Sept. 3, 1897.

In 1898 I delivered in the Summer School of the University of West Virginia the same courses that I had given the previous year at Chicago, and also gave about the same public lectures. This one was delivered with the same title as there, July 22, 1898.

On May 12, 1898, I was invited by Mr. Lewis J. Janes to give one of the "Cambridge Conferences" that he was conducting, and also to give a lecture at Burlington, Vermont, the date to be fixed for some time in November, and the two to come near enough together to avoid the necessity of making two journeys to New England. I decided to use this lecture for both, and this plan was agreed upon. After delivering it the fourth time (at the U. of W. Va.) I began to be tired of it. Every time I

* *English Men of Science*, p. 12.

had read it I had previously subjected it to considerable alterations, and now I felt that if I used it again it must be thoroughly remodeled. Accordingly, from November 2-18, I rewrote it entirely, making extensive changes all through. It was arranged that I give the Cambridge conference on Nov. 20, and the Burlington lecture on the 21st.

The next year, 1899, while I was making a somewhat extended geological campaign in Oregon and California, I received an invitation from President Jordan of Stanford University, to come there at the close of my season's work and deliver two courses of lectures on sociology. I had had an intimation from Dr. Edward A. Ross, who was professor of sociology there, that I might be asked to do this, and I had brought with me the notes that I had used before, and one or two of my public lectures, but not this one. As I expected, I was asked to give several public lectures, and I wrote to Washington to have this one sent to me, and I delivered it on Oct. 24. For some reason, not now clear to me, I changed the title on that occasion to *Nature and Culture*.

On March 5, 1900, I received an invitation from Mrs. May Wright Sewall, Secretary of the Contemporary Club of Indianapolis, to deliver a lecture before the Club on the twenty-eighth of that month. As the time was short I decided to use this lecture, and it was again delivered at that time and place, with title *Nature and Nurture*.

The manuscript was then allowed to slumber for over four years, but when on May 27, 1904, I received a letter from Prof. J. Q. Dealey, inviting me, on behalf of the Civic Section of the Women's Club of Providence, to give them a lecture in October of that year, I was practically compelled to have recourse to it, as about everything else had by that time got into print. The lecture was therefore duly scheduled for Oct. 5, and on that day delivered for the tenth time, exclusive of its presentation to the Social Science Institute in New York.

At the request of Dr. Edward A. Ross, now Professor of Sociology in the University of Wisconsin, and with the approval of the authorities of that University, I gave two courses in sociology there during the summer session of 1910 while Dr. Ross was absent in China, and, as usual on such occasions, I was requested to deliver several public lectures. One of these was scheduled

for July 5, or only a week after the summer session opened, and I was obliged to use something that was ready. This lecture was still available, and I gave it for the eleventh and last time, but not till after I had worked it all over and reduced it in length. I had then become exceedingly tired of it.

This lecture and, in condensed form, the *Forum* article, contain the root idea of my entire philosophy of human progress, as I have always held it since my schoolboy days. It has never been published in its extended form, but I introduced parts of it into my *Applied Sociology*. Of the two typical illustrations on pages 126-127, of this book, the first, relating to maize, was added when I recast the lecture in 1898. The other, relating to wheat, was in the lecture as originally written. The specimens were collected on June 12, 1877, near Rock Creek, and I think within the present Zoölogical Park. When I gave this lecture in Chicago a number of the ladies in Kelley Hall were present, one of whom was seen to weep over the fate of the poor grass, an event which furnished great amusement to her fun-loving companions. She might have quoted at them the lines of Emerson,

"And the poor grass shall plot and plan
What it will do when it is man."—BACCHUS.

The *Forum*, New York, Vol. II, No. 4, December, 1886, pp. 340-350.

THE relative claims of the inherited and the acquired have long been argued. How men of mark come to make their mark is always an open question. How much to attribute to genius, how much to circumstances—who shall say? Whether "blood will tell;" whether what is within will come out; or whether, under certain conditions, it may not always stay in; whether the born poet has not also to be made or make himself; whether there really is any such thing as a "self-made man," and if there is, whether he is superior to other men—these are some of the problems which the thoughtful student of life always finds before him demanding solution.

For our present purpose, these problems may all be reduced to that of the relative claims of genius on the one hand, and opportunity on the other. No one will deny the potency of genius as a factor in success; neither will any candid person deny that even genius may encounter insuperable barriers; and all must admit that, as a matter of fact, success in all cases is the product of two forces—the force from within and the force from without—in the entire absence of either of which, however great may be

the other, its achievement is impossible. The question, therefore, always really is, not whether the result was accomplished by the one or by the other, but, rather, which one of the two contributed most to its accomplishment.

Hence, in discussing the causes of success or failure in human effort, there may be found no difference in the degree of efficacy of these two forces, or, if there be a difference, it can never be measured by any accepted standard. But, whatever the equality in the factors themselves, it is evident at a glance that they have attracted a very unequal degree of attention. We find, in fact, that far greater praise is bestowed upon the internal than upon the external elements of success.

The reason for this is not far to seek. These personal elements reside in and seem to characterize the individual. They mark him off from the rest of the world, and single him out as the special object of admiration. It is the exhibitions of genius, the special displays of physical or intellectual power, the judicious use of talents combined with industry and perseverance, that rivet the gaze, and, when the result is attained, all honor is accorded to these qualities. Little or no notice is taken of the peculiar circumstances which favored its accomplishment, and without which it would have been impossible. These are not accounted as factors in the result; they are rarely recognized as existing, or, if recognized, they are assumed to offer themselves to the unsuccessful as well as to the successful. The idea prevails that genius is omnipotent, an idea which has been crystallized into the homely proverb, "Where there's a will there's a way;" and we often hear of men who "create the circumstances" which are requisite to their success.

But, aside from crude popular opinion, which should not, perhaps, be expected to perceive the impersonal agencies at work in society, we find that the current of scientific opinion runs exactly parallel to it, and we here see the individual still held up to view as the central figure in the panorama of events. Scientific men talk of heredity, of the cumulative transmission of qualities, of the conservation of latent attributes and their reappearance through atavism, while Galton has combined the scientific and the popular conceptions in his expression, "hereditary genius." The literature of the world centers round a few great geniuses, and the history of our epoch will be very much such a record of the achievements of the kings of thought and action in modern times, as the history of past ages has been of those of the kings of political states.

Into this department of history I do not now propose to enter, and, in leaving it to those who have chosen it, I do not know that I need apologize for choosing the less fascinating, less tangible side of this two-sided problem, and venturing to appear for those impersonal influences outside of the agent, which by their pres-

ence or absence permit, or do not prevent, the accomplishment of cherished results. I thus shirk the dilemma by choosing the horn on which others never hang their hopes. I leave the claims of genius to the panegyrists of genius, and pass from the individual to the environment.

I have not, however, selected this thankless task merely because it is new and difficult. I have chosen it chiefly because it is important. In biology the importance of the environment is fully recognized. In the arts of agriculture and stock raising, which consist in the creation of an artificial environment advantageous to man, the recognition of this principle has yielded his chief sustenance. But it applies to sociology as rigidly as to biology, and the exact homologue of this culture of plants and animals, when extended to man, is education in its broadest sense.

The worshipers of genius and the expounders of heredity alike maintain that these qualities are inherent, and that, unless implanted before birth, they can never appear in life. They are, then, the constants in the social problem. If this be true, they are not affected by all the praise bestowed upon them. This adulation of genius is, therefore, a *brutum fulmen*. But it becomes evident that the products of genius will depend wholly upon the degree of freedom with which it is allowed to act. This, however, is the same as saying that results will be proportioned to opportunities. While, therefore, from this point of view, we may regard the study of the individual as interesting and scientific, but sterile, we must regard the study of the social environment as equally interesting and scientific, and at the same time highly fertile in the direction of securing the fruits of heredity, and the very success which genius aims at. It would, therefore, clearly be far more profitable to take up the cause of opportunity, to show what has been accomplished through it, what has failed for want of it, and what the great constant factor, heredity, may accomplish by its aid, which must otherwise fail of accomplishment.

But we may go farther. The adoration of genius is unphilosophical as well as unprofitable. Properly understood, it implies imbecility. It is due to the real rarity of success, which implies the frequency of failure, and so long as we disregard the external elements of success, this implies the scarcity of the internal elements. That this is the popular view is proved by the fact that genius is looked upon as a rare gem, and mediocrity as the normal condition. This I regard as a wholly false view, and against it I venture to maintain that the rarity of success is chiefly due to the absence of its external elements, that it is success itself rather than genius that is generally worshiped, that the internal elements are not rare, but abundant, and that, if the external elements could be correspondingly supplied, what now pass for

feats of genius would merely represent the normal activity of the race. The reverence for genius would cease, but the fruits of genius would be multiplied.

What modern society most needs is to abolish this god Genius to dethrone the monarch Success, to do away with the present oligarchy of brains, and to establish a true democracy of ideas, based upon an equal chance for all.

The first declaration in the American *magna charta* is that "all men are created equal." The equality here implied, as everybody knows, was merely an equality of rights, not of capabilities. But there is a sense in which all men may truly be called equal. More than a century ago Helvetius asserted and defined this form of equality, and it has been reasserted, with proper modifications, by both Comte and John Stuart Mill. In what sense, then, are all men equal? Not, certainly, in the sense that all are equally capable of performing a given intellectual operation. No such claim has ever been made. This "*identité mentale*," or "*homogénéité de l'esprit humain*," is a broad generalization, which swallows up the inequalities of the individual in the equality of the social class. Within every class there are all degrees of intellectual power. One class is the intellectual equal of another, in the sense that individuals selected at random from one class are as likely to prove capable of a high state of development as if taken from another. The chances for the discovery of native genius are the same in all classes, whether we look among the high-born and rich, the middle classes, or the poor and lowly.

It used to be supposed that if a talented person was found in the lower ranks of life this must prove that he had noble blood in his veins, and the romances of the middle ages usually end by the production of evidence that the hero or heroine was stolen from noble parents, or otherwise transferred when young from the higher to the lower ranks of life. In ancient times, when much more care was taken to prevent the mixing of blood, there may have been some basis for this theory of superiority. And it is said that, among uncivilized races, where only the ruling classes are allowed enough to eat, and all others are kept for generations in a state of bondage and drudgery, the chiefs and leading men are much larger in stature, and more vigorous mentally and physically, than the mass. But, in the present civilized world, this state of things has long since ceased to exist. Inter-marriage among different ranks, neglect of the education of women, the effeminating luxury of the rich and the ennobling industry of the poor, have combined to bring about a state of things which fully justifies the law of the average equality of all classes, as above stated.

That this is widely believed is proved by public opinion, which, the reverse of that of the last centuries, now constantly boasts

of the number of self-made men, *i. e.*, men who have risen to some form of eminence from the lower ranks of life, and struggled up from obscurity by their own exertions, unaided by fortune or nobility. This reaction against the old theory of hereditary genius has, however, gone too far, and the efforts of modern writers to check it are not uncalled for. But their remedy is faulty, and they largely fail to grasp the problem requiring a solution. The new aristocracy of brains is as bad as the old aristocracy of blood. It assumes inequality, and tends to place the few alleged geniuses in position to prove their theory, while debarring all the rest from the possibility of disproving it.

The establishment of a true aristocracy of brains may be admitted to be the great desideratum, but it can never be attained by making assumptions. The scientific method is that of induction. The problem is to find who the real geniuses of society are. This can never be learned by giving all the opportunities to a class of assumed geniuses, and denying them to all the rest. It can only be arrived at by extending every possible opportunity to every member of society.

The improvement of the race of men is the highest object that can enlist our energies. There are two ways in which this can be successfully attempted artificially. One of these consists in the practical recognition of the laws of heredity, the other in the practical recognition of the influence of the environment. The former must be something more than the mere admiration of high qualities when they appear. This adds nothing to the present occasional and spasmodic appearance of these qualities. It must consist in their rational and systematic culture, not different from that which has been so successfully applied to animals and plants, where the laws of heredity are no more uniform than among human beings. While I am not now defending this side of the great question of race improvement, I nevertheless regard this as the only course, from the point of view of heredity, that holds out the least promise of practical results.

What, then, can be said of the other plan of race improvement, that through post-natal development? At the outset let it be frankly conceded that the capacity for the display of high qualities must exist, else these qualities cannot be displayed; the germs of excellence must have been previously implanted by heredity, if they are ever to be developed by education. But the possession of the elements of worth—the capacity for excellence—is a very different thing from the manifestation of worth—the attainment of excellence. To those who believe that high attributes only exist in those who actually display them, it must indeed seem impossible to improve the race by education. But this is not the case. The germs of some form of talent exist in a latent state in nearly every undeveloped intellect, and may be brought out by opportunity. The possessor is himself usually

unconscious of them. Opportunity, therefore, must not merely be offered and accepted; it must be actively thrust upon him. The greater part of the energy of the race is thus dormant, and simply needs to be aroused. The few scattered scintillations of genius that now display themselves, instead of being the objects of vacant astonishment, are to be interpreted as the evidences of enormous hidden forces to be set free.

There is no need to search for talent. It exists already, and everywhere. The thing that is rare is opportunity, not ability. The fact that many do struggle up out of obscurity does not so much show that they possess superiority, as that they happen to be less inextricably bound down than others by the conventional bonds of society. And those who have succeeded in bursting these bonds have usually done so at such an immense cost in energy, that their future work is rendered crude and well-nigh valueless. Such is the character of most of the results accomplished by so-called self-made men. To attain to a position where they can labor in any great field, they must carry on a life-long battle against obstacles; they must display enormous individuality, amounting to conceit; they must become heated contestants and bitter partisans. All this narrows the mental horizon, and renders the results superficial and unenduring. There is no more vicious popular fallacy than that the powers of the mind are strengthened and improved by adversity. Every one who has accomplished anything, against adverse circumstances, would have accomplished proportionately more had such circumstances been removed. The talent that can fight against adversity is never of the highest and best quality. Between honest work and open warfare there is a certain incompatibility. True greatness is timid and recoils before obstacles. The finest and most genuine of all qualities—those which, if allowed free scope, will produce the greatest and most enduring results—will not brook opposition, and shrink from the least sign of hostility. Far from implying cowardice, this is simply the characteristic modesty of true greatness. It is a paradox of daily observation, that those who are the nearest right are the least convinced of it; and hence those who possess the greatest truths are often deterred from uttering them against opposition, not from any fear of opposition, but from fear of the possibility that after all they may not be true. It is due to this principle that the greatest intrinsic merit never comes to the surface. True merit will not create its opportunities. It requires that opportunities be brought to it. If this is not done there is no result, and society is the loser. Nearly all the work of permanent value that has been done in the world has emanated from men possessing these qualities, and left undisturbed in their continuous exercise. The greatest blessing of the world has been leisure, for though it may sound paradoxical, it is in leisure that the

grandest work has always been performed, while from toil no great progressive consequences have ever flowed. Leisure engenders thought, which toil never does, and the thought of a moment may project a mechanism that will perform the labor of hundreds of hands.

When we study history, and see who the true promoters of civilization have been, we perceive how these statements are sustained by examples. The men who have increased the world's stock of knowledge, and placed the race in possession of the secrets of nature and the keys to its control and utilization, are the true benefactors of mankind. A study of the personal history of such men shows that without exception they have been in possession of rare opportunities. They have either been entirely free from the distractions of want and the necessity of toil, or they have found themselves situated in the midst of those scenes and objects which are to constitute their special field of labor, and which furnish the incentive to the effort, however great, which they must put forth in order to achieve success. Examples would be superfluous, as they cannot fail to present themselves to the reader's mind; and as to the alleged exceptions, I doubt whether a single one of them will bear the light of candid biographical scrutiny.

Many persons of an optimistic turn of mind look benignantly over the history of man, and, seeing the great number of individuals who have distinguished themselves by the display of towering qualities, break out in admiration of the grandeur of the race. But the true philosopher, who correctly discerns the significance of these examples, sees in them only signs of the possibilities of the race. The grandeur that he sees is only possible grandeur. For every actual great name in history he sees a hundred potential great names. The present corps of workers in every department of science and culture, and in every land, are viewed kaleidoscopically, and multiplied indefinitely.

Science is only just beginning to reveal the true extent of the latent energies of organic life. Ten years ago, treating of the local distribution of plants, I myself wrote:*

"There is no . . . necessary correspondence . . . between organism and habitat, no . . . necessary . . . harmony between species and environment. This need only exist so far as is necessary to render the life of the species possible. Beyond this the greatest inharmony and inadaptation may be conceived to reign in nature. Each plant may be regarded as a reservoir of vital force, as containing within it a potential energy far beyond and wholly out of consonance with the contracted conditions imposed upon it by its environment, and by which it is compelled to possess the comparatively imperfect organization with which we find it endowed. Each individual is where it is and what it is by reason of the combined forces which hedge it in and determine its very form."

* "Popular Science Monthly," Vol. IX, October, 1876, p. 682.

Since these words were written this principle has been widely recognized by botanists. It is now known that the plants of every region possess the potency of a far higher life than they enjoy, and that they are prevented from attaining that higher state by the adverse influences that surround them in their normal habitat. The singling out of certain species by man, and their development through his care into far higher and more perfect forms to supply his needs, both physical and æsthetic, further demonstrate this law. Man gives these plants a new and artificial environment favorable to their higher development, and they develop accordingly. In a word, he gives them opportunity to progress, and they progress by inherent powers with which all plants are endowed. Once, when herborizing in a rather wild, neglected spot, I collected a little depauperate grass that for a time greatly puzzled me, but which upon analysis proved to be none other than genuine wheat.* It had been accidentally sown in this abandoned nook, where it had been obliged to struggle for existence along with the remaining vegetation. There it had grown up, and sought to rise into that majesty and beauty that is seen in a field of waving grain. But at every step it had felt the resistance of an environment no longer regulated by intelligence. It missed the fostering care of man, who destroys competition, removes enemies, and creates conditions favorable to the highest development. This is called cultivation, and the difference between my little starveling grass and the wheat of the well-tilled field is a difference of cultivation only, and not at

* When I wrote my lecture on *Heredity and Opportunity* in the winter of 1885 and 1886 I had the fixed idea that this grass was wheat. It was collected June 12, 1877, or more than eight years before, and I did not take the trouble to go to the herbarium and examine it and the label. In writing the history of this article, including that of the lecture of which it is a condensation (see supra, pp. 31-34), I consulted my botanical note-books, and found the following entry under June 12, 1877:

"I went over to Rock Creek to look after two things. One was a peculiar grass that I found May 30 (not mentioned under that date), in a very young state in the woods a little south of the Woodley Park Road, and which we readily found again. It proves to be nothing more than simply rye (*Secale cereale*), but the dwarfed and slender state in which it grows interests me very much. It looks precisely like a wild grass and has taken complete possession of a little spot about five yards square where it grows not over a foot high and much reclined, and has very few flowered heads, the upper flowers of which are alone fertile, the lower ones being abortive. The culms are very small and weak and do not at all resemble the cultivated form. A few normal stems are, however, scattered in amongst it, which I could not believe to be the same plant till I examined the spikelets. Is it a case of reversion?"

This illustrates the folly of relying on the memory in matters of scientific observation. The principle, however, which I made it illustrate is not at all affected by the mistake, and the case is much stronger by calling it wheat than it would have been if I had called it rye. Indeed, that would have so lowered the rhetorical effect that I doubt whether I would have used the illustration if I had looked it up.

That paragraph in the lecture is printed in full only in my *Applied Sociology*, pp. 126-127.

all of capacity. I could adduce any number of similar examples from the vegetable kingdom; and the zoölogist, the stock-breeder, and the fancier could furnish equally pointed illustrations from the animal world. But the laws of life are the same in all departments, and even man is no exception to them. Man has developed thus far as the wild animal has developed, as the wild grasses have developed. He has come up slowly, as these have, under a natural environment, under the influence of adverse agencies and of competition. And if as an individual he has at last learned to exercise control over the lower kingdoms of nature, as a social being he has never yet consciously attempted his own liberation from the retarding influence of his natural environment. He has never yet taken measures for the removal of competition and other obstacles to social progress.

There is a school of philosophers, never more strongly intrenched than at the present time, who not only deny the possibility of such action on the part of society, and insist that to attempt it would entail great evil, but who go further, and maintain that competition and adversity are the most effective aids to social progress. They point to the development that has taken place among animals and plants under the laws of natural selection, and deprecate in the strongest terms any attempt on the part of man to interfere with the operation of these laws in society. They forget entirely that civilization itself has been the result of successful interference with these very laws. The cereals, the fruit-trees, and the finest breeds of animals are not the results of natural but of artificial and intelligent selection, and they might as well maintain that these would have produced themselves, as that man can ever attain his highest development without conscious, intelligent, and systematic culture.

The central truth which I have sought to enforce is that, like plants and animals, men possess latent capacities which for their development simply require opportunity. Heredity will surely do its part, and therefore need not be specially attended to, but without opportunity, however great the native powers, nothing can result. I look upon existing humanity as I look upon a pristine vegetation. The whole struggling mass is held by the relentless laws of competition in a condition far below its possibilities. Just as what might be grain is mere grass, just as the potential greening is a diminutive crab-apple, so the potential giants of the intellectual world may now be the hewers of wood and drawers of water. On the theory of equality, which I would defend, the number of individuals of exceptional usefulness will be proportional to the number possessing the opportunity to develop their powers; and this regardless of any of the class distinctions that now exist. This number, in the present condition of society, is not a fixed percentage of the total popu-

lation; it is a fixed percentage only of those who possess opportunity. This class is very small in proportion to the whole, but is capable of being indefinitely extended. But if, with the relative handful who at present possess opportunities, we have such results as we now see, what may we not expect when this favored class is made co-extensive with the entire population?

To the intelligent reader it need scarcely be explained that there is a legitimate and fairly practical way of enlarging this favored class. It consists in arbitrarily placing them under a changed environment favorable to the development of all their faculties. To this process the term education is usually applied, but it must be understood in that comprehensive sense which embraces this complex and fundamental conception. It is so rarely used in this sense, that, to prevent the necessity of explanation and the danger of misconstruction, I have purposely avoided its use. And yet, so great is the progress now being made in the direction of truer and broader ideas of education, that I doubt not many will readily recognize its appropriateness in the present discussion.

In conclusion, I may add that, while I am far from being over-sanguine as to the early realization of such far-reaching reforms, I do not regard such a glimpse into the future as in the least utopian. In a country like ours, where all power resides in the opinions of the people, we have only to suppose them to possess a clear conception of their interests and of the measures necessary to secure them, in order to see such measures adopted and enforced. And while I agree with the *noli-tangere* philosophers and the hereditarians, that legislation cannot be successfully applied to the alteration of the great laws of nature, such for example, as those of heredity, I regard the work of creating opportunities, by which gifted individuals can utilize their powers, as simply in the nature of police regulation, capable of being conducted by any body politic.

December (?) , 1886—Ætat. 45.

215. Report on the Departments of Fossil and Recent Plants of the U. S. National Museum [for the six months ending June 30], 1885

History.—Written Oct. 19–20, 1885.

Annual Report of the Board of Regents of the Smithsonian Institution showing the operations, expenditures, and condition of the Institution to July, 1885, Part I, Washington, 1886, pp. 40–41; Part II, pp. 50–51.

December (?), 1886—Ætat. 45.

216. Report on the Department of Plants in the U. S. National Museum [for the six months ending June 30], 1885

History.—I made two reports, one to the Secretary of the Smithsonian Institution and a special one to the Director of the National Museum. In both reports I modestly refrained from emphasizing the fact that I had donated my entire herbarium to the U. S. National Museum. I had previously offered to do so on condition that space be made for it on the South Balcony where the fossil plants were installed and where I did my work, but half of the balcony and tower rooms were then occupied by the collection of mammals. On Jan. 29, these were removed and the entire balcony and laboratory rooms were assigned to me as the Department of Fossil and Recent Plants. On Feb. 1, my entire herbarium, including the cases in which it was kept, built specially for it when my house (No. 1466 R. I. Ave.) was built, was moved to the Museum and placed in the west tower room. This collection, as stated in my reports, contained about 5,000 species and 15,000 (printed 1,500 by a typographical error) specimens. It contained all the plants of the vicinity of Washington, which numbered 1,384 species according to my check-list of 1881, and which had been increased to over 1,400 by later additions. But I had made extensive collections throughout the West, especially from Utah, and from other parts of the country, thus about doubling the District flora by my own efforts. Then I had been actively exchanging with other botanists for many years, and had in this way again at least doubled my own collections. Many duplicates remained for exchange and all were included in the donation. It was regularly

recorded as an "accession" to the Museum collections. These accessions are all numbered, and this was No. 15,986. The entry occurs in the "List of Accessions to the U. S. National Museum during the first half of 1885, together with descriptive notes and indices," on page 207 of the *Report*, and reads thus: "HERBARIUM. A fine and extensive collection, containing 15,000 specimens (5,000 species), with large collections of seeds, herbarium cores (misprint for cases), paper, etc. LESTER F. WARD, U. S. Geological Survey, 15,986. '85. (XIII, B)."*

Lest this might seem to the reader a meager acknowledgment of so generous a gift, I will add that on May 2, I received the following communication:

SMITHSONIAN INSTITUTION

SPENCER F. BAIRD,
Secretary.

WASHINGTON, D. C., May 1, 1885.

DEAR SIR: I notice among the list of accessions to the National Museum of the last few days your very magnificent donation of your private herbarium, and beg that you will accept the thanks of the Smithsonian Institution for your liberality in this respect.

Very truly yours,
SPENCER F. BAIRD.

Prof. LESTER F. WARD,
National Museum,
Washington.

Ibid., Part II, pp. 135-136.

* XIII is the number of the Department of Plants, A, fossil, B, recent or living.

December (?), 1886—Ætat. 45.

217. Bibliography for the six months ending June 30, 1885

History.—My bibliography was regularly kept up, and furnished for the period covered by each report.

Ibid., p. 173.

LESTER F. WARD. List of all plants added to the flora of Washington and vicinity from April 1, 1882, to April 1, 1884.

Proc. Biol. Soc. Washington, ii, 1885, pp. 84-87.

This is a continuation of the general catalogue as published in Bulletin 22, U. S. National Museum, and conforms in arrangement, type, &c., as nearly as possible with that publication.

Extras printed April 10, 1884.

—— Report of the department of fossil plants, U. S. National Museum, 1883.

Report of the Smithsonian Institution for 1883 (1885), p. 263. (Also in Report on National Museum, pp. 27-28, published as a separate.)

January 26, 1887—Ætat. 45.

218. The Use and Abuse of Wealth

History.—Written Nov. 13 to Dec. 22, 1886. This was the first article that I had ever been asked to write. On Nov. 10, Mr. Metcalf wrote, strongly urging me to prepare an article for the *Forum* on the influence of wealth on character. I had not made that subject a special study, although, of course, I had my ideas. After due reflection and the exchange of a few letters, I proposed the above title, which met his approval, and I proceeded to write the article. I did my best for the subject, blocking it out by Dec. 13, and then entirely recasting it. I must admit that I was not specially moved to write it, and that the honorarium was the chief incentive.

The *Forum*, New York, Vol. II, No. 6, February, 1887, pp. 549-558.

THE practice of inveighing against wealth as a social evil in and of itself has well-nigh ceased in modern times. It has become clear to most intelligent minds that, in the competitive system upon which civilization rests, the only margin for progressive activity lies in the leisure which wealth vouchsafes to a few earnest and capable individuals. Assuming the necessity of the existing social organization, or, rather, ignoring the possibility of any other, most people now hail the opportunity that wealth affords for securing and improving leisure as the most potent of the existing agencies of intellectual and æsthetic progress. No one, it is true, can fail to perceive how narrow this working margin of civilization is; but in the contemplation of the results this is not fully realized, and it can be clearly understood only by thoughtful comparison of these actual results with possible ones under a different system. For the class from which the fruitful workers must be selected is necessarily a very limited one. The percentage of people of means to the whole

people is always an exceedingly small one, as everybody knows, but how much smaller still is the proportion of those who improve to those who possess these rare opportunities! There are good reasons for believing it no greater here than it would be for the much larger class who are denied them.

The socialists are trying to devise a system under which the power to work effectively for society shall no longer be confined to this limited class who happen to possess means, but shall be extended to all who have the ability and the disposition; and they claim that this would proportionally increase the effective working force of society. If this reasoning could be accepted as sound, and the socialists' claims could be admitted as true, the scheme would, indeed, be a grand one, and the ideal, however difficult to realize, would be worthy of all effort. But this theme is far too broad for the present article, and it is no part of my purpose to discuss it in any of its general bearings. Only from a single and very restricted point of view can it be touched upon here. Without attempting to compare or to contrast the two numerically so unequal classes, those sufficiently wealthy to insure them leisure and the means to pursue objects and studies without regard to gain, and those who must devote their energies to what are known as practical affairs—the rich on the one hand and the poor and middle classes on the other; without attempting to weigh the relative intellectual, moral, and æsthetic worth of these classes, let it suffice to cast a glance into the inner life of the first of these groups, and consider a few of the influences which operate within it in the direction of reducing the proportion of those who can be claimed as useful to society. Assuming, for the time being, that the existing social order is the best attainable, that the present inequality is a healthy one in insuring leisure to a number of individuals which, though relatively small, is large when considered by itself, let us simply inquire whether the best use is made of this leisure, and whether there is not room for improvement in this respect.

It is not necessary to confine this inquiry to those rare cases in which superior faculties are combined with superior advantages. The work of the genius is "dynamic." He not only advances the age in which he lives, but he gives it new powers with which to advance itself. It is not to be expected that a very large number would be able to do this if they were ever so highly favored. But this is not the only kind of usefulness. The greater part of all work must always belong to a class which, in contrast with this, may be called "statical"—work which exerts only a temporary influence, and only upon those who are near. These statical activities may be compared to waves in still water, which do their appointed work and then die away; while dynamic activities are like the current of a river, which rolls perpetually onward, swelling as it advances. Yet this

latter class of activities derives its superiority from its power to increase the energy of the former class, and the well-being of society depends at last upon the intellectual and physical state of its members, *i. e.*, upon the character of the prevailing social statics.

With the general progress in moral ideas it is becoming more and more clearly realized that wealth is not an absolute possession, but a trust for the benefit of society. Hence generous subscriptions are frequently made for the relief of suffering caused by fires, floods, earthquakes, etc.; heavy endowments are made to charitable and educational institutions, and large bequests are left to further philanthropic objects. Large fortunes thus, in a rude and imperfect way, become the reserve funds of society, upon which it draws in cases of emergency. We can imagine public sentiment so far advanced in this direction as to render such a use of these reserve funds quite general. Nothing is so powerful as fashion, and if the hoarding of vast wealth were to be visited with unanimous disapprobation, the incentive to hoarding would be removed without removing the incentive to acquisition, and a somewhat healthy circulation of the social life-current might be kept up.

While the value of wealth, as an alleviator of suffering and a promoter of worthy public objects, is thus strongly appreciated by many who possess it, its value as a direct means of intellectual and moral culture is rarely discerned by this class. Many rich people are fully alive to their duty toward others, and at the same time apparently devoid of a sense of their duty toward themselves. The function of wealth, in affording leisure for culture and for thorough, painstaking work in any field of progressive labor, has always been and always must be a far more important one than that of furnishing temporary relief to suffering humanity. Without leisure, Humboldt could not have explored all the realms of nature, and given the world an intelligible Cosmos. Without immunity from care, Newton could not have found out and unfolded to his age and ours the true nature of the universe. Without leisure and resources, Darwin could not have fathomed the mysteries of life, and solved the great problem of being. Civilization, with all its mechanical accessories and material blessings, is the product of calm deliberation and patiently wrought results. The inventions that underlie it were impossible until the principles of nature upon which they rest had been established, and this has in most cases been the result of prolonged researches made for truth's sake alone, without any but the most shadowy conception of the consequences that were to flow from them. This scientific work, this search for truth for its own sake, can only be successfully prosecuted when the means of subsistence are made to be not in the least dependent upon it. In proportion as scientific,

literary, or artistic labor is dependent upon its pecuniary returns, its standard is lowered, and its permanence and value are diminished.

The so-called men of leisure, who have accomplished these great results, have really been the most industrious of all men. Leisure, in this sense, merely means relief from the necessity of performing statical work in order to be able to perform dynamic work, as these terms have been defined above. But how few understand it in this sense! The vulgar notion of leisure, secured by ample means, is immunity from all work. So prevalent is this idea that wealthy people are not expected to perform any kind of labor. Many such people look upon any form of work as beneath their station, and suppress the natural impulses that prompt activity. They give freely to the poor, found asylums and endow colleges, and believe that, with this, they have executed their trust. This is a wholly false view. The wealthy have a higher duty to perform. They are under obligations directly to themselves and indirectly to society. Wealth alone does not make true manhood. Birth, rank, social position—none of these can alone make useful men. Not even genius—the inheritance of powerful intellect and exceptional aptitudes—can suffice. Culture alone can make these possessions real. Industry alone can make them count as social factors. The heirs of wealth, the legatees of rank and noble blood, the children of great men, and the descendants of geniuses, are too apt to imagine that nothing is left for them to do. No greater mistake could be made, and none leads more directly to degeneracy. In this age all value is measured by labor, and this is not more true of matter than it is of mind, of material than of mental wealth. What makes one man superior to another is superior acquirement; at least, so far is this the case that the greatest natural superiority, without acquirement, counts for nothing in the world of thought. Every life is an independent unit, and every mind at its origin a *tabula rasa*, inheriting nothing but the capacity to acquire, and the descendants even of the greatest must begin anew, as their ancestors did, at the foot of the ladder and climb by the same toilsome methods.

Few, however, realize what a boon is the bare opportunity to perform this laborious task. This is best seen at those rare institutions of learning where facilities are also extended to students to defray their expenses by some form of labor. Such institutions are few in number, but if they could be multiplied and their existence be made known, they would doubtless be thronged with eager and earnest applicants for a chance to labor and to learn. The poor only ask this chance. They have no conventional qualms to satisfy, no notions of hereditary superiority to stand in their way. Activity is the natural demand of the healthy constitution, and is agreeable. Work is

relished as the true food of body and mind, and is accepted with zeal. Few of this zealous class, however, attain success. The hard realities of life sooner or later break their spirit, quench their ardor, and turn their energies into so-called practical channels which yield little more than livelihood.

When we reflect how eagerly the most meager opportunities are thus seized by the poor, who can help contrasting this with the unlimited opportunities enjoyed by the rich, but usually neglected? This is the class from whom we should have great results. Not only should the children of wealthy parents receive the most liberal education that the country affords, but they should be expected to make a good use of it in after life. As professional men, with complete immunity from the cares incident to poverty, they should deepen and widen the tracks that others are prone to follow, and institute systematic reforms. As men of state, far removed from partisan strife, they should draw their principles direct from history and from science, and lay the foundations of an ideal government. As men of letters they could afford to be content with nothing less than the best, whether in the manner or the matter of their work. As men of science, not obliged to make their investigations yield them a pecuniary return, they, of all others, should devote themselves to the pursuit of truth for its own sake, which, paradoxical as it may sound, has always proved the most important and really practical of all human labor.

But, it may be asked, do not wealthy parents usually educate their children? Do they not send their sons to college? Do they not send them abroad to learn the world, and encourage them to pursue useful vocations? It is not denied that all these things are done, but the results are certainly less satisfactory than they should be. This education is too often given merely at the behest of fashion, and in such manner and amount as fashion requires. The impression is too prevalent among the rich that their only duty is to enjoy life, and the children of wealthy parents are too often made to feel that, not being compelled to work for a living, they are under no obligation to work at all. This sense of independence of the world is apt to be fostered at home. It is felt that even education, by exacting effort, humiliates. The labor necessary to acquire knowledge is looked upon as drudgery, and from this it is an easy step to the habit of thought which looks down upon the educated person as one who carries with him the evidence of having labored and toiled. Every one is familiar with this phase of life. The child in the cradle is surrounded by influences which impress it with the idea of being somehow, by nature, a superior being. The governess, the music teacher, the family tutor, are known to be far better informed than the sons and daughters, but so far from feeling ashamed of this, people in this stage of culture would

rather feel ashamed if they found their children displaying any great amount of learning. Private schools, which are patronized by this class, are well calculated to pander to this sentiment. They are conducted as a business by which the teachers must gain a livelihood. Success here does not mean educational progress, but the attraction and retention of profitable patrons. Every effort is therefore directed to please wealthy parents, and knowing that learning is discounted and native superiority believed in, they readily find means of putting the latter forward at the expense of the former, thereby heightening the false impressions acquired in the nursery.

All true excellence, as the old adage avers, is the result of labor, and a system which despises labor necessarily precludes the attainment of excellence. The young man who is sent to college because it is the proper thing to do, despises the students who must make a heavy sacrifice to secure this opportunity. He would be ashamed to plod as they do, even if his talents were equal to theirs. He considers it rather an honor to be behind in his classes, and boasts of barely escaping failure in the final examination, or of getting through by some trick, or by the help of the influence which wealth commands. His time, while at college, must be spent, not in the drudgery of study, but in the respectable amusements incident to college life. With plenty of money in his pockets, he joins the clubs and rival secret societies, where popularity is apt to be measured by length of purse. Greater or less dissipation is certain, and college life is a mere frolic, from which he returns home scarcely wiser, and morally worse, than when he went. His voyage abroad, if he makes one, is urged, because that is what every young man of his station is expected to do. He travels in the approved manner over the customary routes, and conforms to all the rules of etiquette of the fashionable tourist. He is accompanied by other young men of his own social station, to whose minds the idea of gaining information, or of fitting themselves for future usefulness, is as foreign as to his own. He returns enriched in mind by nothing unless it be the addition to his *repertoire* of a few cock-and-bull stories. That such a preparation wholly unfits one for assuming the responsibilities of life need not be stated. But this example is scarcely an average one of its class. It presupposes sufficient force of character to resist all the greater temptations that beset the pathway of those so circumstanced. Few, however, possess this, and by far the greater number early fall victims to some one or more forms or vice, that soon compass their destruction. To have come through at all is the best proof of the possession of qualities which, properly directed, would have led to certain success.

It is common for the toiling poor to envy the indolent rich, and imagine them happy. This is a great mistake. Activity,

bodily and mental, is the normal state, and in it happiness chiefly consists. Those who are able to satisfy every desire the moment it arises soon become the victims of *ennui*, than which no form of misery is greater, and any type of life which enforces inactivity must be a very unhappy one. Such is believed to be the life of many wealthy people. It has become a truism that happiness is never attained by effort directed to that end alone, but comes only as an incident of effort directed to other useful ends. "The pursuit of happiness," therefore, when taken in a literal sense, is the pursuit of a phantom, and the only successful pursuit of happiness consists in the prosecution of some useful end in life, while the normal activity necessary to this constitutes in itself the true happiness sought.

Now, what the modern age demands of those who possess wealth is that they employ it in the proper direction of their activities. No right-minded artisan begrudges the millionaire his millions. The manufacturer, the merchant, and even the railroad king are stirring, industrious men. They organize the production, exchange, and distribution of wealth, and are essential to society. So of other industrial operations. Concentrated capital is indispensable to their prosecution on an adequate scale. And those on whom devolves the duty of conducting these industries, and who accept and perform this duty as responsible citizens, are not envied nor denounced by sober-minded people, however widely their lots may differ. But honest and industrious people, those who with hand or brain labor for society, create its wealth, and effect its proper distribution—all, in fact, who really work—have a right to complain that so much of the wealth of their creation has fallen into the hands of idle persons who despise every form of labor, even the ennobling pursuit of science, art, and authorship. They do not ask them to take up the blacksmith's sledge, the carpenter's hammer, or the mason's trowel. They even prefer that they devote themselves to higher and really more useful labors—labors which their leisure, means, and independence peculiarly fit them to perform thoroughly and well.

Great revolutions are often caused by persistence in old habits in defiance of a changed public sentiment, and they might in most cases be prevented by a wise recognition of this change and a gradual conforming to its demands. The people are frequently forced into open revolt by an obstinate refusal to do this on the part of those holding power of whatever kind. Most past revolutions have been political, and aimed at liberation from some form of despotism. The revolutions of the future are likely to be social, not directed against the State, but against a power higher than the State—the power of wealth—producing great monopolies and sustaining a large non-producing and idle class,

or caste, sheltered behind the forms of law, but odious to the changing spirit of the age.

That moral ideas change and progress is well known to all students of history. Customs and institutions that are sanctioned in one age are condemned in the next. There are races in which theft is honorable, and the time may come in the most enlightened countries when certain of the present most successful modes of money-getting may be condemned as crimes; and some of the present titles to the tenure of wealth may yet be called in question. With the growth of democratic institutions the idea of a general supervision and control by the people of the commonwealth for the common good has taken a firm root, and the demand that those individuals into whose hands large portions of this wealth has, by whatever means, fallen shall render an account of their administration of it is becoming more general and imperative. The plea that possession proves the possessor to have earned his title is rebutted by the patent fact that most large fortunes are merely inherited. The number of those who have amassed large fortunes by organizing and successfully conducting great industries is always small. To-day they may be counted on the fingers. But a large business, once firmly established, is carried on thereafter by the exercise of only the ordinary capacity, and goes on enriching generations of the descendants of the original financier; while fortunes invested in various securities require only the attention of a competent business agent. It is these unearned fortunes that breed caste and threaten social degeneracy. It is not so much the few colossal fortunes as the many smaller hereditary ones that menace the existing social structure; it is not the accumulators of wealth, but the heirs of wealth, that furnish the drones of society and the enemies of labor.

But labor does not demand the confiscation of any form of wealth. It demands nothing but that a good use be made of it. This threatened degeneracy may be converged into healthy prosperity by awakening in this class a sense of obligation to society. Idleness is no more natural to them than to any other class. If they are idle it is because it is considered a disgrace to work. To change this, and convert drones into workers, it needs only to change this pestilential fashion and make work instead of idleness the order of the day. That this can be done by the power of public sentiment there is no doubt. No class is strong enough to resist the withering frown of popular indignation, and I give this class the credit to believe that they would themselves gladly welcome the overthrow of a disgusting code which forbids them to act their natures and to expand.

Let the present homage to wealth be withdrawn, and be paid only to work; let every man be esteemed, not for what he has, but for what he has done, and possession, now so often a barrier to labor, will become its most valuable auxiliary. It is the ob-

vious duty of the well-to-do classes to avert the impending crisis by defying custom, eschewing luxury and idleness, and taking hold with will and energy of the active duties of life. They claim to constitute a superior class, and they are in position to make good this claim; not in the sense of natural superiority, but by means of the superior facilities they enjoy for making their native powers effective. Let them demonstrate this superiority by the unstinted development of those powers, and their industrial exercise, and no one will dispute their title to the means employed.

April 7, 1887—Ætat. 45.

219. Science and Immortality

History.—On March 25, 1887, I received a request from Dr. Samuel J. Barrows, Editor of the *Christian Register* of Boston, to furnish him with a short article setting forth my views on immortality, to be published in a symposium on that subject. I wrote the article March 27–28, and mailed it to him. No proof was sent me, and in the next to the last line of the last paragraph but one, the word “eternal” was printed “external,” entirely ruining the sense. On April 12, Dr. Barrows sent me the article for any corrections I wished to make, saying that he intended to publish the symposium as a separate pamphlet or booklet. I of course corrected the above-mentioned error. He had written a very brief biographical sketch, which appeared on page 215 of the *Christian Register* containing the symposium. This he asked me to expand, and I did so on April 15. The booklet appeared several months later. This is certainly one of the most remarkable symposiums ever published, as may be judged by the names of the writers. The following are among the most eminent: Charles A. Young, James D. Dana, Asa Gray, Joseph Leidy, Simon Newcomb, Alfred Russel Wallace, Herbert Spencer, T. H. Huxley.

There were many echoes from my article, and before I could shake off the subject I was obliged to write no less than three others, all at much greater length (see *infra*, pp. 59–63; 81–85; 171–179). Buchanan’s *Journal of Man* reduced all the articles to poetry and rhyme, much of which is doggerel and even slang, but somewhat amusing. The following is the fate of my contribution:

As for immortal life, I must confess,
Science hath never, never answered “yes.”

Indeed all psycho-physical sciences show,
 If we'd be logical we must answer no!
 Man cannot recollect before being born,
 And hence his future life must be "in a horn."
 There must be *parie ante*, if there's a *parie post*,
 And logic thus demolishes every future ghost.
 Upon this subject the voice of science
 Has ne'er been aught but stern defiance.
 Mythology and magic belong to "*limbus fatuorum*"
 If fools believe them, we scientists deplore 'em.
 But nevertheless, the immortal can't be lost,
 For every atom has its bright eternal ghost.*

* Buchanan's *Journal of Man*, New York, Vol. I, No. 5, June, 1887, pp. 15-16.

The *Christian Register*, Boston, Vol. LXVI, No. 14, April 7, 1887, pp. 211-212;
 Science and Immortality. The *Christian Register* Symposium revised and
 enlarged. Edited and reviewed by Samuel J. Barrows. Boston, 1887,
 pp. 24-27. (Condensed in *Public Opinion*, Washington and New York,
 Vol. III, No. 1, April 16, 1887, p. 18.)

IN reply to your note of March 23, inviting an expression of my views on some questions in regard to the relations between "science and immortality," I submit the following as the best I can do in the limited space allowed:—

To your first question, as to whether there are "any facts which make it difficult to believe in the immortality of the personal consciousness," I give an affirmative answer, which may be briefly set forth under two heads, as follows:—

I. The consciousness, when scientifically examined, reveals itself as a quality of brain, or mode of manifestation of the molecular activities of the organized brain substance.

It is a universal induction of science that modification of brain is accompanied by modification of consciousness, and that destruction of brain results in destruction of consciousness. No exception to this law has ever been observed. The conclusion is, therefore, almost a necessary one that brain is the cause of consciousness, and that consciousness depends upon and varies with the nature and condition of the brain.

The facts in support of this are multitudinous, not only as derived from exhaustive experiments in psycho-physics, conducted expressly for that purpose, but also as derived from common observation on the effect of drugs, intoxicants, poisons, and of various injuries and diseases of the brain.

It follows that, so far as science can speak on the subject, the consciousness persists as long as the organized brain, and no longer.

II. A second class of facts, which are irreconcilable with a belief in the indefinite persistence of consciousness, is found in

the inability of all minds to recall states of consciousness and events antecedent to the present life. For immortality can have no claim to the consideration of rational beings, unless it means absolute independence of time and causation. All things that have a beginning must have an end. The law of the material world is change, which implies both beginning and end of all phenomena. A phenomenon that is assumed to begin at some given point of time and to continue thenceforth forever is, to the logical mind and especially to the scientific mind, a palpable absurdity. Therefore, for immortality to be believed in by rational beings, it must be shown to embrace an eternity *a parte ante* as well as a *parte post*. It might be conceded that no evidence of the latter was to be expected; but, when we contemplate consciousness as the immortal part, it should certainly carry constantly with it the evidence of antecedent states. And, if it be urged that memory is not necessarily involved in consciousness, then it must be answered that its persistence is no more to us than its renewal would be through other individuals, as in reproduction, since it is through memory alone that a consciousness of identity in different states can exist.

To the second question as to whether there is "anything in the discoveries of science which would support or strengthen the belief in immortality," I must answer that none of the alleged facts of this class have thus far presented themselves to my observation or reason in such a manner as to justify me in accepting them as facts.

My answer to your third question, whether I consider such inquiries "out of the pale of science altogether," naturally flows from the foregoing. I certainly do consider the question of the continuous existence of a consciousness which began with birth or conception, or at any point of time, as not only out of the pale of science, but as belonging to the *limbus fatuorum* of mythology and magic; for it would be nothing less than an eternal phenomenon, which involves a flat contradiction of terms.

I would not have it inferred from the above that science is skeptical as to the immortality of the soul. Science postulates the immortality, not of the human soul alone, but of the soul of the least atom of matter. Consciousness results from the eternal activities of the universe, is their highest and grandest product, and not one atom nor one atomic movement is ever lost. The immortality of science is the eternity of matter and its motions in the production of phenomena, and science will always object to all unphilosophical attempts to confound phenomena with these.

May 26, 1887—Ætat. 45.

220. The Immortality that Science Teaches

History.—Written April 29 to May 10, 1887. On April 21, Mr. B. F. Underwood, then editor of the *Open Court*, asked me to write a four-column article on *Immortality*, and I agreed to do so, proposing the above title which he accepted. The paragraph quoted from *Dynamic Sociology* occurs on pages 367-368 of volume I.

The *Open Court*, A Fortnightly Journal devoted to the Work of establishing Ethics and Religion upon a Scientific Basis, Chicago, Vol. I, No. 8, May 26, 1887, pp. 199-201.

THE concluding paragraph of the short contribution that I made to the symposium, in the *Christian Register* of April 7 last, has called forth so many interrogatories, and appears to have been so little understood, while at the same time attracting so much attention, that it has seemed to me almost a duty to expand and explain it. The paragraph is as follows:

"I would not have it inferred from the above that science is skeptical as to the immortality of the soul. Science postulates the immortality, not of the human soul alone, but of the soul of the least atom of matter. Consciousness results from the eternal activities of the universe, is their highest and grandest product, and not one atom nor one atomic movement is ever lost. The immortality of science is the eternity of matter and its motions in the production of phenomena, and science will always object to all unphilosophical attempts to confound phenomena with these."

Probably the most satisfactory way to answer these questions and elucidate the whole subject would be to refer all who are interested to my *Dynamic Sociology*, in which this and many other important psychological problems are treated as parts of a general system of philosophy which, in its scope at least, claims to be complete. But the argument as presented in the fifth chapter of that work could only be partially appreciated without a

previous acquaintance with the series of considerations which lead up to it, as they are set forth in the two chapters that precede it; so that a suitable preparation for intelligently comprehending, not to say accepting, my point of view, would require the careful reading of at least three chapters, or nearly 200 pages of that work, while to be in condition to see the matter in precisely the same light as I see it would require the reading of the entire work, or some 1,400 pages. While I should, of course, be glad to have any who are interested in my views perform the first, or even the second of these tasks, I certainly cannot ask it, and do not expect it, and hence I will attempt in such a manner as I shall be able within the limits of this article, to make clear the one point in question. In doing this, however, I may perhaps be permitted to quote one paragraph from the work referred to, which will state the question and indicate the answer in a clearer and more forcible manner than I could now do by the use of other words:

"The property of consciousness must therefore be assumed to inhere in every molecule of protoplasm to a certain limited degree, which in certain definitely shaped masses becomes so far increased in intensity as to be inferable from the actions of such individualized portions of the substance. From this simple state increment is added to increment throughout the whole course of organic development, until the highest manifestations are reached. Conversely, we are compelled to predicate of each component of a protoplasmic molecule some trace of the same property, which is the proper basis for the theory of a universal soul in inanimate nature. It exists, but for want of organization it is too feeble to be perceptible to the human faculties, or to work any appreciable effects. It is thus that science at length agrees with vulgar opinion as to the existence of mind in nature; but there remains this fatal difference, that instead of magnifying it into omniscience, it reduces it to practical nescience, and declares that increase in mind-force can take place only in proportion to increase in organization. And while molecular or chemical organization may so far intensify it as to render it perceptible to the human faculties, molar or morphological organization may carry it up to the exalted height to which it attains in the *élite* of mankind. The only intelligence in the universe worthy of the name is the intelligence of the organized beings which have been evolved, and the highest manifestation of the psychic power known to the occupants of this planet is that which emanates from the human brain. Thus does science invert the pantheistic pyramid."

Now, if there is one truth that science has taught more forcibly than any other it is that we can know only phenomena, and next to this it has taught that we are ourselves phenomena. It was Kant who said, "*Der Mensch ist selbst Erscheinung*," and this truth science has a thousand times confirmed. It applies to everything that constitutes man, his body and mind, his intellect, senses, and will.

A phenomenon, etymologically considered, is that which appears. To appear implies a time when the phenomenon did not exist as such. But, as stated in the article referred to, a beginning implies an end, appearance implies ultimate disap-

pearance, and a phenomenon is necessarily finite in duration. Man as a phenomenon must therefore share these attributes, and as certainly as he has had a beginning so certainly must his existence as man cease and discontinue altogether.

Where, then, it may well be asked, is the room for immortality? If the whole man is but a transient phenomenon, what is it that shall endure forever?

Science answers this question of the future by pointing to the past. Taking recourse again to etymology we find that the word phenomenon, while denoting change and evanescence, connotes permanence and perpetuity. That which appears must have previously existed, else it could never appear. The phenomenon implies the *noumenon*. It is science and not theology which negatives as absurd the doctrine of the creation of anything out of nothing. Every phenomenon is a product. It is not a magic apparition. The elements that compose it existed before they assumed that form. They had always existed, and after the phenomenon shall have again disappeared they will continue to exist forever.

These elements are not altogether material. Without discussing the ultimate constitution of matter, and accepting it as a reality and the substratum of all things, we are still compelled to recognize an immaterial part as belonging to that substratum and inseparable from it, but equally independent of all considerations of time. For it is a postulate of science, and one in complete harmony with every observed fact, that the material elements of the universe possess activities by which alone they are capable of being wrought into perceptible forms. These activities are as perpetual and persistent as the material elements themselves, and as inseparable from them as the human soul is from the body. They are the atom-souls of Haeckel, and the true soul of the universe. Just as the material elements when raised to the plane of perceptibility become substance, so the immaterial elements when raised to the same plane become property, and in the two we have respectively the basis of all quantity and quality.

These transcendental elements of nature are the stuff of which all phenomena are made. They are the true noumena, or things in themselves, and they alone endure amid all the changes of time. They possess, moreover, the "promise and potency" of the highest life, the grandest thought. But they are not themselves life and thought; these are phenomena, their visible products. They have been evolved from this raw material during eons of change. They have embodied themselves in long series of increasingly higher forms that have one after another appeared and disappeared in the paleontologic history of our planet. After so long a struggle for higher and higher expression there has come forth at last, as the loftiest flight of nature, the phe-

nomenon man, possessing a physical organ of thought, and capable in his best estate of contemplating objectively the other products of evolution and of understanding in a small degree the laws of the universe.

But now, in the exercise of these truly wonderful powers, we find this being forgetting that he is himself a phenomenon and claiming the attributes of things in themselves. Yet, so far is he from possessing this right, that he is really, of all nature's earthly products, the most remote from the primordial cause of things. The lowest animal or plant is nearer its origin than man is; the "physical basis of life," protoplasm, is nearer than the lowest organized creature, and further progress toward the absolute source of being leads back through the organic and inorganic substances to the simplest element of chemistry, and still back to the tenuous ether of interstellar space.

So far, again, from any part of man being immortal, he shows the vast distance that separates him from that ultimate source by the brevity of his existence as compared with the enduring, but by no means eternal, rocks on which by myriad inscriptions he has sought to perpetuate his memory.

But let it not be supposed that this extremely derivative and comparatively evanescent character of man in any way implies a corresponding lack of importance. On the contrary he stands at the head of a long series of progressive steps in the mechanical organization of the primal force of nature, in each of which steps this force has been made more effective. Organization consists in the concentration and focalization of the elements of nature to render them effective in the production of results. It is the machinery, or economic gearing up of the universe, and the results are as much greater than those of unorganized nature, as the achievements of the age of machinery are greater than those of the ages before machinery had been introduced. Consciousness, reason, intelligence, and inventive genius represent the maximum of mechanical organization in the world. Civilization is their result, and in place of primeval forests we have enlightened populations; in place of wild beasts we have statesmen and philosophers working out the problems of life, mind, and society. Yet all the powers of this exalted being, man, are but the original forces of nature intensified many thousand fold through organization. The unorganized activities of the universe are feeble and ineffective for any conscious purpose. Their energy is scattered and diffused, and wastes itself in aimless and profitless work. Just as in war, in government, and in industrial economy, it is organization that achieves success, so has it been with the elements and forces of primordial nature, and what science denotes by the terms organic progress and biologic evolution is simply the progressively higher organization of these elements

and forces, from the bathybian ooze of the sea-bottom to the developed brain of a Napoleon or a Newton.

But all this implies no increase in the amount of either the matter or the motion of the universe. Just as the rays of the winter sun may, by the sun-glass, be intensified to the point of burning, just as the unnoticed electricity of the atmosphere may, by the Ruhmkorff coil or the Leyden jar, be converted into a thunderbolt, so the diffused and imperceptible "mind in nature" may by similar concentrated direction be made to display the attributes of consciousness, reason, and intelligent thought.

It is something to have learned that there exist, have always existed, and will ever continue to exist, the indestructible and unchangeable elements and powers out of which, through similar processes, equal, and perhaps far superior, results may be accomplished. This is the immortality that science teaches, the faith that inspires the genuine student of nature, and this pure and ennobling sense of truth he would scorn to barter for the selfish and illusory hope of an eternity of personal existence.

May 28, 1887—Ætat. 45.

221. False Notions of Government

History.—Written March 9–23, 1887, under the title: *Growing Conceptions of Government*. It was written from impulse with no special destination in mind, but carefully composed, the outline finished on the 16, and then wholly rewritten. I sent it to Mr. Metcalf on the 24, without any idea as to whether he would accept it. He objected to nothing but the title, which he wanted to be more popular. I sent him several others to choose from and did not know which one he selected till I received the proof on April 21. More than five years after this paper had appeared, considerably more than half of it was reprinted in the *Cleveland Citizen*.

The Forum, New York, Vol. III, No. 4, June, 1887, pp. 364–372; The Cleveland Citizen, Cleveland, Ohio, Vol. II, No. 84, Labor Day Edition, September 3, 1892, p. 5.

THERE is perhaps no more unfortunate term in the language than the word “government.” Besides having a harsh sound it has a harsh meaning. In its primary sense, to govern is to interfere with the liberty of action. It is to command and to prohibit, to exact and to refuse. Nothing is more unpleasant than this, and hence everybody naturally objects to being governed.

Whatever may have been the origin of the word as applied to the central authority in a state, it must be admitted that, until a comparatively recent date in human history, the governments of the world had always done so much of this kind of governing that it had come to be looked upon as almost their only function. However constituted, when once in existence they had considered it their privilege to govern in this objectionable sense. From this have arisen most of the great struggles

that peoples have had to make for liberty, *i. e.*, for relief from this kind of government. And when one government had been overthrown another was immediately organized, which soon proved as oppressive as the first. Hence there gradually grew up a wide-spread popular distrust of all government, amounting often to positive hatred.

This deep-seated dread and detestation of government has been salutary in the extreme. It has resulted within the last two centuries in abolishing, throughout all the most enlightened states of the world, all real governmental oppression. The so-called monarchies of Europe that survive (Russia excepted) are monarchies only in name, and some of them, as for example, Sweden, are more representative than some countries that style themselves republican. The royal prerogatives are pared down to a minimum, ministers perform all executive duties, and the legislators are chosen by the people to make laws which neither crown nor ministry dare violate.

Both in the monarchies and in the republics, as now constituted, the old forms of governmental abuse are impossible. The only oppression practicable in them is that which the people themselves sanction. The power of majorities to oppress minorities still exists, but in practice it is inoperative. For such is the popular sense of justice that if a majority undertakes to practice any real wrong upon a minority, enough voters will speedily go over to the minority to convert it into a majority, and secure the redress of the wrong. Knowing this, and wishing to remain in power, the government, *i. e.*, the officers of any given administration, is careful to refrain from shocking this public sense of justice, and no serious attempts to wrong the minority are made.

There is another reason why none of the objectionable methods of government are any longer possible. Everything must now be done according to law. There is scarcely any discretionary power. The laws are made by representatives chosen by the people, and these do nothing but carry out to the best of their ability the will of their constituents, who, in turn, constantly watch them and scrutinize their vote on every measure. The executive branch can do nothing but execute these laws, and this it does with great fidelity and exactness. Rarely, indeed, do we hear of cases in which an executive officer has exceeded his authority as expressly given in some statutory enactment, and nearly as rare are the cases in which such enactments are not faithfully executed. Such officers may at first imagine that they are going into places where they can exercise some discretionary power, but they soon find that every duty is specifically prescribed, and that all they can do is to perform it as they must swear that they will do. Very few ever have the least desire to overstep their authority. Those who are intrusted with funds are powerless to appropriate them to their own uses. The crude

popular notion that the officers of government have nothing to do but help themselves to the people's money is disproved at every change of administration. A treasurer of any modern state finds himself, on admission to office, in the midst of the system of checks which renders any attempt at fraud unsuccessful, and which is itself an almost infallible detective of any irregularities on the part of officers and subordinates.

In fact, throughout the entire system of a modern representative government, the limitations that exist to the violation of law, the perpetration of fraud, or the abuse of power, are so great and so effective that it is only at rare intervals that such things are practiced or attempted. This statement is no less true because of the prevailing popular impression to the contrary, and the persistent attempts of a certain class of journals to inculcate the belief that wide-spread corruption and constant malfeasance in office are the characteristics of public life. It has been shown over and over again that losses through dishonesty are very much less in public than in private financial transactions, and scarcely a case can be named in which an officer has undertaken any high-handed proceedings in excess of his prescribed duties.

It thus appears that government now is a very different thing from what it formerly was. The so-called "rulers" are the most innocent of men, having neither power nor desire to do evil. If evil is done it is because they have been instructed to do it by those who choose them. This, as a general proposition, is perfectly true, and only needs such special qualification as arises from the imperfection of human nature and human institutions. I have brought it prominently into view in order to point out a fundamental fallacy in most of the current reasoning about government.

So deep-seated had become the fear of governmental oppression, and so firmly had this sentiment taken root in the constitution of man, that not even the complete revolution which it wrought throughout the civilized world has sufficed to eradicate it. It still exists, and permeates the entire body politic. The most representative forms of government are still feared, watched, and suspected as if they were self-constituted despotisms.

Most persons regard this as a healthy state of things, and one calculated to prevent abuses and forestall dangers. This is by no means the case. On the contrary, its effects are extremely injurious in a variety of ways. In the first place, good men will not subject themselves to this unjust censorship, and will have nothing to do with government, and thus the tone of government is greatly lowered. Again, this feeling tends to produce a thoroughly false and perverted idea of what government really is. In consequence of it the voter imagines he is conferring vastly more power upon his candidate than it is possible to confer. He looks upon the public officer as a sort of lord, capable of exercis-

ing arbitrary power, and thus a glamour is thrown over government which completely obscures its true and simple character. This intensifies party spirit and the strife to gain control of the government, which is regarded in the light of booty to be captured. A corollary to this reasoning is the notion that public offices are merely spoils belonging to the victor. And here it should be remarked that, contrary to popular belief so often reiterated, this system of frequent rotation in office, due to political vicissitudes, is in no sense a democratic idea, but is a relic of past ages of abuse of power, when kings and despots made and unmade the fortunes of men. The test of progress toward true democracy is the constantly diminishing power of the ruling class and the adoption by government of business principles in conducting the affairs of the people. From this the so-called spoils system is the farthest remove conceivable.

The old idea of government was that it was a power essentially hostile to the people, but fastened upon them by fate. The modern survival of this idea contemplates government as a "necessary evil." No matter how representative it may be it is still looked upon to a great extent as an arbitrary personality, with great power and evil intent, requiring the exercise of "eternal vigilance" to prevent it from destroying all liberty. Many who know better are unable to divest themselves of this view, and entertain it as a mere hereditary instinct. In fact, it is one of those late social instincts of self-preservation, which persist, as all instincts do, long after the conditions under which they were developed have passed away.

This irrational distrust of government not only makes it worse than it otherwise would be, but, so far as this is possible, it tends to give it the character it is accused of possessing. When any one knows that he is believed to possess great power he will try to exercise more power than he legitimately has. Whenever modern governments do exercise power not vested in them by the people it is because they are conscious of this false sentiment, which ascribes to them more power than they have any claim to. The occasional instances of municipal mismanagement and malfeasance are doubtless attributable to this cause.

But, bad as all these consequences are, they are trivial compared to that which we will now consider. The most disastrous effect of this false public sentiment is that it deprives government itself of its chief element of usefulness to the people, viz., its power to protect society.

Without going back over the history and reputed origin of government, it will not be disputed that its primary purpose is protection. In the earlier and more primitive types of society the chief protection required was that against the crude physical elements of human nature that perpetually conflicted and destroyed all peace. These still exist, perhaps undiminished, and

it is not denied that they are fairly and effectually held in check by government. But besides these, in the modern epoch of vast undertakings and complicated civilization, there has grown up another class of social evils against which protection should be secured, which is far more dangerous than that of brute force, sporadic passion, and low animal cunning. I refer to the evils of organized aggrandizement, the abuse of wealth, and the subtle processes by which the producer of wealth is deprived of his share in it. These evils have grown up with civilization, and are simply the organized expression of human acquisitiveness. They are the natural products of an advancing intelligence without moral restraint. In short, they represent the rule of mind, which is no more moral than is the rule of muscle. Without government the latter would have prevailed; the weaker would have gone to the wall; the "fittest," in the same sense that zoologists use that term, would have survived; but what society would have been no one dare conjecture. But in the unregulated rule of mind we are able to see some of the results. Yet it has, as it were, but just begun, and no one can predict its ultimate consequences. They are so bad now that the leading question must soon be, How shall society be protected? Under the system as it now exists the wealth of the world, however created, and irrespective of the claims of the producer, is made to flow toward certain centers of accumulation, to be enjoyed by those holding the keys to such situations. The world appears to be approaching a stage at which the laborer, no matter how skilled, how industrious, or how frugal, will receive, according to an oft-quoted law of political economy, only so much for his services as will enable him to "live and reproduce." The rest finds its way into the hands of a comparatively few, usually non-producing, individuals, whom the usages and laws of all countries permit to claim that they own the very sources of all wealth and the right to allow or to forbid its production.

These are great and serious evils, compared with which all the crimes, recognized as such, that would be committed if no government existed would be as trifles. The underpaid labor, the prolonged and groveling drudgery, the wasted strength, the misery and squalor, the diseases resulting, and the premature deaths that would be prevented by a just distribution of the products of labor, would in a single year outweigh all the so-called "crime" of a century. This vast theater of woe is regarded as wholly outside the jurisdiction of government, while the most strenuous efforts are put forth to detect and punish the perpetrators of the least of the ordinary recognized crimes. This ignoring of great evils while so violently striking at small ones is the mark of an effete civilization, and warns us of the approaching dotage of the race.

Against the legitimate action of government in the protection

of society from these worst of its evils the instinctive hostility to government, or "misarchy," above described, powerfully militates. In the face of it the government hesitates to take action, however clear the right or the method. But it is proper to point out that this groundless over-caution against an impossible occurrence would not in and of itself have sufficed to prevent government from redressing such palpable wrongs. It has been nursed and kept alive for a specific purpose. It has formed the chief argument of those whose interests require the maintenance of the existing social order in relation to the distribution of wealth. Indeed, it is doubtful whether, without the incessant reiteration given to it by this class, it could have persisted to the present time. This inequitable economic system has itself been the product of centuries of astute management on the part of the shrewdest heads, with a view to securing by legal devices that undue share of the world's products which was formerly the reward of superior physical strength. It is clear to this class that their interests require a policy of strict non-interference on the part of government in what they call the natural laws of political economy, and they are quick to see that the old odium that still lingers among the people can be made a bulwark of strength for their position. They, therefore, never lose an opportunity to appeal to it in the most effective manner. Through the constant use of this *argumentum ad populum* the anti-government sentiment, which would naturally have smoldered and died out after its cause ceased to exist, is perpetually fanned into life.

In view of all this, it becomes clear that nothing is so much needed at the present time as the removal of the popular error on this point. It is the duty of all those who have the true reform of society at heart to point out in the most convincing manner that the people are no longer in any danger from governmental oppression, that their present danger lies in an entirely different direction, that what they really need is more government in its primary sense, greater protection of the exposed masses from the rapacity of the favored few, and that, instead of distrusting and crippling government, they should greatly enlarge its power to grapple with these evils. Let it be insisted upon that this is nothing but the re-clothing of government with its original power to protect society. It was for this that it was instituted, and unless it does this it has no right to exist. Originally it undertook to make protection complete. It extended it to all cases of social abuse. It recognized the natural inequalities of citizens, and had no other object than to see to it that none should thereby be debarred from their rights. But then the inequalities were chiefly individual and personal. They were therefore natural, and hence governmental protection certainly must have counteracted to some extent the law of the

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survival of the fittest. With the progress of civilization all this has been changed. Social inequalities are now the result of circumstances, of accident. They are artificial. The strongest are no longer the best physically or mentally. They are merely the favored, often the pampered and degenerate. How much more, then, should protection be vouchsafed to the victims of such inequality! Yet for such there is no protection in law or government.

The great evils under which society now labors have grown up during the progress of intellectual supremacy. They have crept in stealthily during the gradual encroachment of organized cunning upon the domain of brute force. Over that vanishing domain government retains its power, but it is still powerless in the expanding and now all-embracing field of psychic influence. No one ever claimed that in the trial of physical strength the booty should fall to the strongest. In all such cases the arm of government is stretched out and justice enforced. But in those manifold and far more unequal struggles now going on between mind and mind, or rather, between the individual and an organized system, the product of ages of thought, it is customary to say that such matters must be left to regulate themselves, and that the fittest must be allowed to survive. Writers of a certain school are fond of appealing to Malthus, Darwin, and Herbert Spencer, and strongly deprecate the bolstering up of the weaker elements of society. They picture the degeneracy that must follow all attempts to oppose the "immutable laws of nature." Yet, to any one who will candidly consider the matter, it must be clear that the first and principal acts of government openly and avowedly opposed these same laws in preventing, through forcible interference, the natural results of all trials of physical strength. These laws of nature are violated now every time the highway robber is arrested and sent to jail.

Primitive government, when only brute force was employed, was strong enough to secure the just and equitable distribution of wealth. To-day, when mental force is everything and physical force nothing, it is powerless to accomplish this. This alone proves that government needs to be strengthened in its primary quality—the protection of society. There is no reasoning that applies to one kind of protection that does not apply equally to another. The only question that need be asked is, whether justice is done. If justice is not done it should be enforced by the state against any and all opposing interests. It is utterly illogical to say that aggrandizement by physical force should be forbidden, while aggrandizement by mental force or legal fiction should be permitted. It is absurd to claim that injustice committed by muscle should be regulated, while that committed by brains should be unrestrained.

I am aware that in expressing these views I do but utter the

thought of a considerable number of able and active writers and thinkers upon current social and political questions. They constitute the nucleus of a practical social philosophy which must sooner or later solve all the knotty questions of the time. For this they need only to become the property of the general public and to be so firmly grasped by the great mass as to form an intelligible code of political action. Above all, the working people should realize that the government is their own and will be just what they make it. They should learn to look upon it as a creature of their will. They should cease to fear and distrust it, and should seek to mold and shape it. They should turn a deaf ear to those who seek to use it as a scarecrow to frighten them into inaction. If they are to secure from government that protection which forms its only claim to exist, they must throw off all party allegiance, and demand of all candidates the strongest pledges of fidelity to their interests, and sustain none who do not honestly and earnestly fulfill those pledges. They need no revolutionary schemes of socialism, communism, or anarchy. The present machinery of government, especially in this country, is all they could wish. They have only to take possession of it and operate it in their own interest.

The true solution of the great social problem of this age is to be found in the ultimate establishment of a genuine people's government, with ample power to protect society against all forms of injustice, from whatever source, coupled with a warm and dutiful regard for the true interests of each and all, the poor as well as the rich. If this be what is meant by the oft-repeated phrase "paternal government," then were this certainly a consummation devoutly to be wished. But in this conception of government there is nothing paternal. It gets rid entirely of the paternal, the patriarchal, the personal element, and becomes nothing more nor less than the effective expression of the public will, the active agency by which society consciously and intelligently governs its own conduct.

July 21, 1887—Ætat. 46.

222. Administrative Report for the Year Ending June 30, 1885

History.—Written June 28, 1885.

Sixth Annual Report of the U. S. Geological Survey for the year ending June 30, 1885, Washington, D. C., 1887, pp. 81-85.

July 21, 1887—Ætat. 46.

223. Synopsis of the Flora of the Laramie Group

History.—Written March 17, to July 22, 1885. This memoir represents my first systematic work in paleobotany, the ones published earlier (see Vol. III, Nos. 180 and 183, pp. 378-385 and 388-394) being wholly preliminary and historical. As has been already said (Vol. III, No. 145, p. 202), I transferred my allegiance from the U. S. Bureau of Statistics, of which I was librarian, to the U. S. Geological Survey in the spring of 1881, and was made chief of the Division of Fossil Plants, which Division had never existed before. I was then a recognized botanist, and in several of my botanical papers I had drawn attention to the value of the study of the extinct floras of the globe, which seemed to me to belong as much to botany as that of its existing floras, and the subject interested me intensely. When offered by Maj. Powell my choice between the study of Indian languages in the U. S. Bureau of American Ethnology and that of fossil plants on the U. S. Geological Survey, I therefore accepted the latter with-

out hesitation. I wanted to take the field immediately. I had never done any field work in geology. All I knew of geology had come from reading, which had been somewhat extensive, but I felt its utter inadequacy. While in the field in 1875 with a geological party I was obliged to confine my labors to living plants. When, one day, we stopped to examine a bed containing shells, I studied their occurrence as fully as possible, and some blocks of silicified wood that I found in Rabbit Valley, Utah, riveted my attention, but I could not even collect any specimens. But could I learn to find fossil plants, and how could I determine their age when found? I felt the need of being initiated into this new and fascinating field by accompanying some experienced geologist and paleontologist. I had made the acquaintance of Dr. Charles A. White, whose eminence in these lines need not be emphasized by me, and I understood that he was to make an expedition that same season. On April 11, 1881, or only three weeks after I had entered upon my new duties, I consulted him on this subject and asked him if he would have any objections to my joining his party. He was greatly pleased with the idea, and said he was going to investigate the Laramie Group and wished I would study its flora while he studied its fauna. The matter was brought to the Director's attention on the 13, and he approved of the project. He said he would like to have us study the geology and paleontology, fauna and flora, of the Laramie Group along the line of the Union Pacific Railroad. We could not go till after the first of July when the appropriations for the next fiscal year would be available.

Dr. White and I had many an interview on the subject during the succeeding two months, and perfected all our arrangements. As our operations are reported in full in my administrative report (see Vol. III, No. 184, pp. 395-400) for that year, they need not be further mentioned here. Suffice it to say that I got well initiated into my new work and brought back large collections of fossil plants. These did not arrive till late in the fall and remained the whole winter and spring in the boxes in which they came. I was wholly unprepared to commence the work of determining fossil plants, was busy organizing the Compendium work (see Vol. III, No. 142, pp. 129-130), and was compelled to acquaint myself better with the literature and history of the science. I wanted to get and read more books on the subject and did an immense

amount of bibliographical work, inducing the Geological Survey to purchase no less than 150 memoirs that could not be found in any of the libraries of Washington.

I did not take the field in 1882, but had the boxes unpacked in July. On July 28, 1882, I made my first attempt to determine a specimen. But I was not yet ready for this, and I did not follow up that line of work. The kinds of work that engrossed my time may be gathered from the papers that I published (see Vol. III, Nos. 166 and 189, pp. 292-297 and 412-416). I tried again in January, 1883, to determine some of the plants, but did not make much headway. Dr. White made a small collection of plants in the season of 1882 in the Yellowstone Valley, which was turned over to me, and I did considerable work on it (see Vol. III, Nos. 149 and 158, pp. 241 and 275-276). The great problem was that of having drawings made of these fossil leaves, and this was partially solved in the spring of 1883, when Mr. Everett Hayden invented ingenious methods of photographing them, tracing the nerves on the blue prints, and then bleaching the latter, leaving the ink drawings.

I resolved to visit the localities from which Dr. White obtained his plants in the Yellowstone Valley, and I organized the expedition of 1883. The collections made this year were immense and very fine. They came in 55 boxes, which were opened Nov. 28, to Dec. 13, 1883. On Jan. 1, 1884, I made a commencement in working them up, and proceeded to classify them botanically. This continued to be my regular work until most of my material was determined. I made a special study of the nervation of leaves and became quite an expert in the business. By the end of 1884 I had determined and named many of the species enumerated in this paper.

On Feb. 13, 1885, I received a circular asking me if I would have a paper for the Sixth Annual Report of the Survey. I then sent in the title of this paper, which underwent no change. I proposed to select from my great collections a representative number of typical plants and illustrate them in the memoir. By March 1, these were all selected. On March 16, I prepared a synopsis of the heads of the paper, and the next day I began writing it. On the 18, Mr. Gilbert requested me to read a paper on a geological subject before the Philosophical Society of Washington, and I gave him the title *The Flora of the Laramie*

Group. It was not called for till April 25, and by that time I had made great progress with my memoir. My paper that evening was late on the program and I had only half an hour before adjournment. I devoted the time to geological considerations. It was concluded at the next meeting on May 9, and I brought a fine array of illustrations which Mr. Hayden helped me to prepare. On April 10, I finished the long *Historical Review of Opinion* as to the age of the Laramie Group. The other two chapters were short and soon finished, but the great task was the compilation of the extended table of distribution, which covers 72 pages of the *Annual Report*, and which was designed to settle the question, so long discussed, as to whether the Laramie is Cretaceous or Tertiary. Work on this had been going on simultaneously with the writing of the historical review, but it was not completed till June 5, after which I proceeded to discuss it. For this purpose I took it home and wrote the discussion there, so that I could devote the day to the study of the types. This latter was a prolonged labor. Mr. Everett Hayden was very helpful to me. The work was nothing less than the identification of all the most distinctive types of Laramie plants, including my collections of 1881, Dr. White's collection of 1882, and my great collection of 1883. These had been drawn by the process above described, and I therefore had both the specimens and the drawings to work from. We first arranged the figures into groups as nearly similar as possible, trying at least to get families, and largely genera together. Then we had these groups mounted on large pasteboards of rectangular shape. Mr. Hayden devised a stand on which these mounted groups could be arranged so as to revolve and enable me to pass them easily and rapidly in review. I then proceeded to compare all my figures and specimens with the illustrations in the paleobotanical works. I devised a register on slips, and whenever I found a figure sufficiently similar to any of mine to be noted, I recorded it on these slips. The specimens all bore numbers corresponding to the regular museum catalogue, so that it was easy to find them. In this manner I went through the entire literature of paleobotany. It furnished a most excellent basis for the determination of the collection.

On July 15, I finished the text proper of the memoir. All the writing had been done at home evenings and Sundays, and

the Fourth of July. On the 16, I commenced drawing up the list of species, but as yet many were only generically determined. On the 20, I had the types all arranged and commenced describing the species and making comments on each. It was quite a problem to find suitable names for all the new species. On the 21, I began to see that such a plan as I had adopted would not only make the paper too large, but would take so long that I could not get it done in time for the *Sixth Annual Report*. I therefore abandoned the attempt to describe the species, give synonymy, and make comments, leaving that for a separate work (see infra, p. 78), and decided to limit it to a bare list of names and give the localities at which the specimens were collected. The rest was now quickly dispatched. In fact the list was completed the next day, the 22. Mr. Hayden prepared the table of contents and list of illustrations while I named the remaining species, and on the 23, I sent the manuscript and drawings to the Survey for publication. The drawings were not yet mounted on plates, but were sent to the Division of Illustrations. I went there on the 24, and arranged to have them photo-engraved.

A somewhat extended geological reconnaissance had been planned, of which I was to be a member, and I joined it on the 27, and did not return till August 31. The paper had then gone to the Government Printing Office, and on Sept. 4, I went there on call and discussed with the foreman the best way to set up the great table of distribution. Proof began to arrive on the 17, and I did little else than read it till it was all done on Oct. 20. The work on the plates was far behind the letter press. The drawings were enlarged two diameters and were sent to a photo-engraving company to be reproduced in half-tone natural size. Sets were sent to me to mount on plates. As the descriptive paper (see infra, p. 78), which was also to be illustrated, was to follow this soon, two sets of plates had to be mounted at about the same time. The size of the plates was different for the two papers, the other being octavo. It was not till March 23, 1886, that I was able to submit the set of plates for this memoir. Proofs of the plates began to reach me on April 8. They were not all received and corrected till near the end of July. I prepared an elaborate index to the whole paper, but it had to be merged with that of the volume. That

was printed and the proof corrected in August. Everything was out of my hands on August 21. At the Government Printing Office it often required six to nine months after everything was done that the authors could do before a volume could be brought out. In this case the volume did not reach us till June 22, 1887. It bears date 1885, which is wholly inexcusable. I received my reprints at the same time or a day sooner. These I distributed very widely both at home and abroad. The index of the volume is, unfortunately, not stitched at the end of the reprints in this case.

Ibid., pp. 399-557, pl. xxxi-lxv.

September, 1887—Ætat. 46.

224. Types of the Laramie Flora. Bulletin of the United States Geological Survey, No. 37, Washington, Government Printing Office, 1887

History.—Written October 24, 1885, to February 2, 1886. This is the descriptive paper corresponding to, and completing my *Synopsis of the Flora of the Laramie Group*. In writing the history of that paper I stated (*supra*, p. 76) that I first contemplated describing the species and making extended comments, but that its limits forbade this, and I was obliged to content myself with a bare list of the names and a statement of the locality where each type was collected. This decision was made on July 21, 1885, and I deferred the work of describing the species until that paper was out of the way. This work was begun on Oct. 24, and constituted my principal occupation from that date till it was completed on Dec. 27. All the stages in the progress of the work are recorded in my notebooks. The species were already named and were arranged in their systematic order in the *Synopsis*. The nomenclature of Bentham and Hooker's *Genera Plantarum* was followed, but not the order of arrangement. In this I followed the revised classification proposed in my *Sketch of Paleobotany* (see *supra*, pp. 26–27), and earlier papers, although it had not yet been embodied in the manuals and standard systematic works. It is now virtually adopted by the entire botanical world, and amounts practically to a complete reversal of the system adopted when I wrote. For the species already named I introduced a tolerably full synonymy and a profusion of references. These latter were

made possible by the plan already described (*supra*, p. 75) of making a slip register of all figures in the entire literature that sufficiently resembled my plant. It was also this slip register of figures that enabled me to compare my figures with those that had been referred to other species in the discussion of the types. Professor Lesquereux thought I carried this too far, and perhaps I did.

After the species were all described and the synonymies and discussions written it did not take long to complete the work. It was mainly a matter of revision and was about finished by the end of the year 1885. I wrote the manuscript in pencil, as it was of a character that did not admit of dictation, but as fast as it was written it was turned over to a typist and engrossed in duplicate on the typewriter. The typist could easily overtake me and kept close on my heels, so that when I was through, the whole was practically done. We reached the end on the last day of the year, but it was necessary to compare the typewritten copy very carefully with the original draft. This work consumed the month of January, 1886. On Feb. 2, all was completed, and I took it to the Director in person.

At first it was a question whether to repeat the illustrations, which were all to appear in the *Sixth Annual Report*, but both Maj. Powell and Chief Clerk Pilling preferred to do so. It was easily done, and on Feb. 9, Mr. Everett Hayden took a duplicate set of the photo-engravings and rearranged them on plates of smaller size for the *Bulletin*. The manuscript was changed to correspond and soon went to the printer. It happened that in this case the plates were printed in advance of the text, namely in September, 1886, while proof of the letter press did not begin to come till Feb. 26, 1887. The text was all in forms on March 21. I had had a slip index of the manuscript prepared, and as fast as the pages arrived the printed page numbers were substituted for those of the manuscript. The manuscript of the index was then prepared, forwarded, and put in type without delay, and the last of the proof corrected on April 11. When I returned from a campaign in the Yellowstone National Park on Sept. 22, the *Bulletin* was out. I bought two copies, and obtained a few more by a kind of pretended exchange. The law relating to Bulletins forbade their free distribution. The recipient must either pay for them (cost plus 10 per cent) or send in exchange

an equivalent in value. Such a law is prohibitory, since scientific men do not want the works of others, but want others to receive their works. They will not correspond with libraries or bureaus, but only with other authors direct, and that method is not recognized by the law. In consequence of this "iron-clad" law the Monographs and Bulletins of the Survey molded in the basement of the building. By straining the law to its utmost a few copies were sent to leading paleobotanists. I think the bulk of the edition is still piled up at the Survey, if it has not been ruined by various agencies.

Bulletin of the United States Geological Survey, No. 37, Washington, Government Printing Office, 1887.

October 8, 1887—Ætat. 46.

225. [Divine Origination of Matter, or of Man]

History.—On May 13, 1887, I received a letter from Mr. Charles M. Davis, Secretary of the American Institute of Christian Philosophy, asking me to answer the following question:

Have persons of acknowledged scientific authority specifically denied the divine origin of matter, or man, and placed such denial on logical grounds? If so, when and where?

The answer was wanted by August 10, and I learned that there were no funds out of which to pay me for my work. I was very busy with other articles that were remunerative, and I naturally took little interest in this matter. Nevertheless I managed to sketch a reply by the seventh of June, and turned it over to Mr. H. P. Gerald, who was interested in it, and who supplied several of the quotations and made a clean copy of the whole. In this form it was sent on July 26. This article gave me my second opportunity to have Darwin's letter to the German student published (see Vol. III, No. 160, pp. 279-281).

Christian Thought, New York, Vol. V, No. 2, October, 1887, pp. 130-135.

IN reply to the question propounded to me through your favor of May 11th last by the Executive Committee of the Institute of Christian Philosophy, as to whether persons of acknowledged scientific authority have specifically denied the Divine origination of matter, or man, and placed such denial on logical grounds, and if so, when and where, I beg leave to say that it would probably be somewhat difficult to collect numerous

instances of the precise nature prescribed in the question, for several reasons.

In the first place, "persons of acknowledged scientific authority" are not in the habit of specifically denying anything but statements of fact proved to be erroneous, and in such cases the denial is not based on *logical* grounds, but on the production of the negative evidence.

In the second place, such persons do not dogmatize about questions that are beyond the range of the faculties of observation, as is clearly the question of the origin of matter and of man. If any positive statements upon this question occur in the writings of scientific men, it should be understood that they are merely meant to represent the opinions of these men as derived from the evidence in their possession, and the apparently dogmatic form of statement is solely to avoid prolonged and repeated qualifications which would be incompatible with good style.

In the third place, science is essentially constructive and not destructive—though in some cases it is necessary first to clear the ground of obstructing doctrines before any tenable hypotheses can be erected thereon, and this clearing process is often regarded as destructive—and any who should doubt the Divine origination of matter and man would do so because they supposed they perceived evidence of their natural origination; and their method, instead of denying the former, would be to present the evidence in favor of the latter.

The form of your question, therefore, practically precludes the possibility of answering it very definitely and at length in the affirmative, since it would require those belonging to the class defined by it to do that which would in itself tend to exclude them from that class.

Just here I would beg to call your attention to a possible ambiguity in your unqualified use of the word "Divine." There are those who, holding that "whatever is, is Divine," would make this word apply to *any* origin of matter or life. I have assumed, however, in understanding your question, that you use it in the ordinary sense, not as including both the natural and the supernatural, but as referring to the theologically supernatural as opposed to the scientifically natural.

The evolutionary account of the origin of certain species and genera, as Man (without claiming that this hypothesis must be already held as fully demonstrated), is a natural account and violates no known laws. The theological account of the origin of certain things, as Man from the dust of the ground, or Woman from the masculine rib (according to the second story of creation as told in Genesis), is a supernatural account and requires a Deity working beyond any known natural laws to produce this result. This latter (without implying any opinion as to its truth, and ignoring the fact that there are numerous other accounts

of similar nature) may justly be considered an account of the "Divine origination" of man. So too the origin of matter conceived as created out of nothing would be a "Divine origination" of matter.

But while many may have a clear and logical opinion as to the origin of man, when the question as to the origin of matter is presented to men of "acknowledged scientific authority" they are prompt to reply that they know nothing about it, and that science at present has no means of knowing anything positive on the subject, however well convinced they may be that certain stories of its origin are false. Science has not yet worked back to "In the beginning," and she is careful not to assert knowledge where the data of that knowledge cannot be had. No competent scientist has yet reached the question as to the absolute origin of matter, yet its Divine "origination" in the sense of being created out of nothing, has been abundantly and specifically denied by practically every non-theological philosopher who has had occasion to consider the subject at all. The great trend of such philosophy has been to look upon matter as eternal, uncreatable, and indestructible; and any query as to its origin would be regarded as on a par with one about the boundaries of space.

Coming to what is properly the second part of the question, as to whether persons of acknowledged scientific authority regard the evidence now in the possession of science as unfavorable to the conception of a Divine origination of man, in contradistinction to a natural origination, it may be stated clearly that many of the very highest scientific authorities do so regard it. That several of them have stated their objections to this conception, not only on "logical grounds," but by legitimate inductive arguments with the presentation of the evidence, is a matter of general information.

To refer to only one such person, a striking and trite instance of a man of "acknowledged scientific authority," whose work and line of thought have led him to consider the question as to the origin of things somewhat carefully, is Prof. T. H. Huxley. I will cite simply three passages from his writings, which show that when called upon to express an opinion as to the "Divine origination" of man, he gives forth no uncertain sound:

(1) "I do not know of any rational conception or theory of the organic universe which has any scientific position at all beside Mr. Darwin's. I do not know of any proposition that has been put before us with the intention of explaining the phenomena of organic nature, which has in its favor a thousandth part of the evidence which may be adduced in favor of Mr. Darwin's views. Whatever may be the objections to his views, certainly all others are absolutely out of court." (See his sixth lecture "On the Origin of Species." The passage may be found in the

Humboldt Library of Popular Science Literature, No. 16, p. 222.

(2) "There is but one hypothesis regarding the origin of species of animals in general which has any scientific existence—that propounded by Mr. Darwin." (See his "Evidence as to Man's Place in Nature," Chap. II. Printed also in Humboldt Library, No. 4, p. 232.)

(3) "My belief, on the contrary, is, and long has been, that the Pentateuchal story of creation is simply a myth." (See recent article by him in the *Nineteenth Century*. Reprinted in the *Popular Science Monthly*, April, 1886, p. 795.)

It is well known that the two most important works that Darwin wrote, the "Origin of Species," and the "Descent of Man," were devoted to demonstrating the natural origination of all animals, and particularly of man. Prof. Ernst Haeckel—the Darwin of Germany—goes further and declares for the unity of law, or monism, in all departments of nature. As further illustrating the views of these two pre-eminent scientific authorities, although, perhaps, not precisely in line with the interrogatory formulated by you, I may possibly be permitted to introduce, in concluding my reply, a bit of history that is known to very few readers of English, either in the religious or the scientific world.

* The great memorial address on Darwin and his predecessors which Prof. Haeckel was invited to deliver before the Association of German Naturalists and Physicians which met at Eisenach on the eighteenth of September, 1882, next following the death of the English savant, was telegraphed in English as soon as delivered to the leading scientific journal of England, but to the great surprise and chagrin of those who knew what it contained, a certain portion was expunged from the latter. (See *Nature*, Vol. xxvi., Sept. 28, 1882, p. 540, column 2.) I happened to glance over the address as it appeared in the *Deutsche Rundschau*, and to detect the missing passage, including a most important letter from Charles Darwin to a German student, Nicolas Baron Mengden, not otherwise made public, but unfortunately here translated into German. I was unable to refer to the original English of this letter, until some months later I received from Prof. Haeckel's hand the revised address in pamphlet form, in which the letter as written by Darwin was given as a foot-note. I have made a translation of the part omitted from *Nature*, in which the letter occurs, and would offer the whole as having a bearing upon your inquiry as well as a general interest for both Christianity and Science. It runs as follows:

"That even Charles Darwin was penetrated by this religion of nature, and was no short-sighted adherent of any special sect, is obvious to every one who is acquainted with his works. But as some of his countrymen immediately after his death stated the contrary, and as a few bigoted priests have even glorified Darwin as an orthodox follower of a specific confession of the English

Church, we may be permitted to refute this falsehood by an unequivocal proof. I am so fortunate as to be able to produce an inestimable document, hitherto unknown, which leaves no doubt on this point. A studious young man, animated by an honest zeal for knowledge, whom I had the pleasure of seeing again a few months ago among my pupils at Jena, had become perplexed through the reading of Darwin's works about the Christian belief in revelation, which he had hitherto regarded as the most valuable foundation of his convictions. Pressed by serious doubts, he wrote to Darwin and asked him for enlightenment, especially as to his views of the immortality of the soul. Darwin sent him back word, through a member of his family, that he was old and unwell, and too much burdened with scientific labors to be able to answer these difficult questions. But the young truth-seeker did not rest content with this, and again addressed to the revered old man an appeal as touching as it was urgent. This time there came as an answer a letter from Darwin, written and signed by his own hand, in the following words:

“DOWN BECKENHAM, KENT.

“June 5, 1879.

“DEAR SIR,—I am much engaged, an old man, and out of health, and I cannot spare time to answer your question fully—provided it can be answered. Science has nothing to do with Christ, except so far as the habit of scientific research makes a man cautious in admitting evidence. For myself, I do not believe that there ever has been any revelation. As for a future life, every man must judge for himself between conflicting vague probabilities.

“Wishing you happiness,

“I remain, dear sir,

“Yours faithfully,

“CHARLES DARWIN.*

“After this open confession no one will any longer be in doubt that the religion of Charles Darwin was none other than that of Goethe and Lessing, of Lamarck and Spinoza. This monistic religion of humanity stands in no way in antagonism to those fundamental doctrines of Christianity which establish its true value. For the universal love of mankind as the fundamental principle of morality is contained in the former as in the latter. Its original source, as Darwin has shown, is to be sought in the social instincts of the higher animals, those psychic functions which the latter have acquired through adaptation to coöperative social life, and have transmitted to men through heredity.”

* This letter was quoted in the second anniversary address by the President of the Institute of Christian Philosophy and published in the first volume of *Christian Thought*, October, 1883, p. 100, and widely republished.

October 29, 1887—Ætat. 46.

226. [Biographical Sketch]

History.—Written April 15, 1887, at the request of Dr. Barrows, (See supra, No. 219, p. 56.)

Science and Immortality, etc., pp. 136–137.

LESTER F. WARD, A.M., of Washington, is one of the geologists of the United States Geological Survey, having vegetable paleontology for his branch of the service. He is also connected with the National Museum as Honorary Curator of Botany and Fossil Plants. He has published as a bulletin of the National Museum a *Guide to the Flora of Washington*, and in the Annual Reports of the Geological Survey a *Sketch of Paleobotany* and *Synopsis of the Flora of the Laramie Group*, which are forerunners of larger works in preparation. His best known work is his *Dynamic Sociology*, in two volumes, which embodies a complete system of philosophy from an American stand-point. The scientific journal *Science* pronounced this work "America's greatest contribution to scientific philosophy." Mr. Ward has been a constant contributor for the last twelve years to the leading scientific periodicals and magazines.

December, 1887—Ætat. 46.

227. [Lesquereux's Criticisms of the Synopsis of the Flora of the Laramie Group by Lester F. Ward, and the Latter's Reply Thereto]

History.—Written Oct. 14, 1887. Professor Lesquereux, to whom I sent my memoirs, had the great courtesy to send his criticisms to me instead of publishing them as he might have done.

They were certainly worthy of publication, and I therefore sent them to the *American Journal of Science* with such a reply as I was able to make. I was not sure it would be published, but thought that Lesquereux's name would carry it. I had not seen the number in which it appeared when on Dec. 14, I received a letter from Professor Lesquereux informing me of the fact.

The American Journal of Science, New Haven, Conn., Third Series, Vol. XXXIV [Whole number CXXXIV], No. 204, December, 1887, pp. 487-489.

January, 1888—Ætat. 46.

228. [The Law of Malthus]

History.—Remarks on the paper of Dr. J. C. Welling on *The Law of Malthus*, read before the Anthropological Society of Washington, Feb. 1, 1887. Written out Feb. 8, 1887.

The American Anthropologist, Washington, D. C., Vol. I, No. 1, January, 1888, pp. 21-23; reprint pp. 1-2.

THE law of Malthus furnishes an illustration of the tendency to attack the higher and more complex problems before studying the lower and simpler ones. Malthus framed a law which was applicable to animals below man and to plants, but not to man, and it was reserved for Darwin to confine it to its legitimate field. Its failure, when applied to human beings, is due to the existence in man of an element only foreshadowed in the highest animals—the psychic element, the intellectual, or inventive faculty. Through this faculty men have the power of completely destroying the relations between the law of population and that of subsistence by regulating both—*i. e.*, by limiting the former and augmenting the latter. Thus far, however, it has been chiefly by the last-named method—*i. e.*, by the nearly unlimited creation of the objects of desire—that this result has been accomplished, and but for the barriers to the equitable distribution of the products of thought and labor, to which I have called attention on previous occasions, there could never be any danger that population would outstrip the means of subsistence. This is strikingly shown by Dr. Welling's illustration of the enormous mechanical power now wielded for man's benefit by the great agency of steam. Almost any other of the modern agencies would have shown the same truth. But the objection might be raised that these are, at most, only accessory to the production of subsistence, which must primarily come from

the soil. Even to this it may be replied that we have as yet scarcely begun to economize the resources of the soil. Experiments already made demonstrate that the earth is now made to yield only a small fraction of what science and skill can obtain from it, so that this apparent limit does not exist in reality. Production—the power to create the means of subsistence—is thus practically unlimited, and the only real limit is that to population itself. The massing of population so densely as to render the entire habitable globe one vast city, though all could be shown to possess an abundant supply for their needs, would be undesirable. But this problem must and would be solved by the application to it of the same great power which man possesses to the exclusion of every creature below him—the power of mind exercised in rational restraint and in the control of the laws of reproduction. The character rather than the number of offspring would, according to a law already manifest in society, become the chief concern, and it would ultimately be the quality instead of the quantity of the population that would continue to increase.

While, therefore, it is intelligence that exempts man from the operation of the Malthusian law, still we find intelligence itself subject to an analogous law of its own. The social system of the savage is comparatively simple, and little intelligence is needed to adapt the individual to it. In civilization this system becomes complicated and intricate, and a great amount of intelligence is required of each citizen to subsist within it. Only by knowing what are the principles underlying the social system, and becoming acquainted with the manner in which they operate to sustain and carry it on, can any member of society be useful or anything but injurious to his fellow men. But the civilized intellect, unprovided with this acquired knowledge, is only a short step above that of the savage. The civilized infant is as blank intellectually as the savage infant; has no longer to live and immensely more to learn. In a word, the natural development of the native capacity for intelligence does not keep pace with the artificial requirements of the civilized state, and we have another Malthusian law, as it were, that “while in the progress of civilization the capacity to acquire knowledge increases only in an arithmetical or some lower ratio, the amount of knowledge necessary to be acquired increases in a geometrical or some higher ratio.”

March, 1888—Ætat. 46.

229. Notice of W. C. Williamson's Memoir
On the Organization of the Fossil Plants
of the Coal Measures, Part XIII, in
Philosophical Transactions of the Royal
Society of London, Vol. CLXXVIII,
1887

History.—Written Jan. 17, 1888.

The American Journal of Science, Third Series, Vol. XXXV [Whole number
CXXXV], No. 207, March, 1888, p. 256.

March 24, 1888—Ætat. 46.

230. The Evolution of Immortality*

* *The Evolution of Immortality; or, Suggestions of an Individual Immortality
Based upon our Organic Life and History.* By C. T. Stockwell, Chicago:
Charles H. Kerr & Co.

History.—Written March 14, 1888.

Public Opinion, Washington and New York, Vol. IV, No. 50, March 24, 1888,
p. 592.

IN this little book we have another of those laudable attempts,
so numerous in these days, to show that the doctrine of im-
mortality rests upon a scientific foundation. Not content,
as wise men are, to take the doctrine on faith as one that
necessarily transcends science which can only deal with the tan-
gible facts perceptible to the senses, these heroic people insist
upon hunting down the soul and ferreting it out of the labyrinth
of vessels, ducts, pores, and foramina of the body. [The demon-
strators of immortality are more modest than they once were.

Dr. Henry More, in his *De Immortalitate Animæ*, established this truth to his entire satisfaction by a formidable array of mathematical, geometrical, and syllogistic proofs, and this was the method in his time, when mathematics and logic were the only sciences recognized. But nowadays every modern science is made to sustain the doctrine, and the proof from each is always complete. It is thus that a few years ago Mrs. Antoinette Brown Blackwell elaborated in a large work her *Physical Basis of Immortality*, and in a recent symposium in the *Christian Register* of Boston some dozen learned scientific men each established it from the point of view of his own special studies.] The author of the present work, who professes to have arrived at his conclusions from "a personal study," whatever that may be taken to mean, has reached the startling result that it is the paternal cell which in reproduction furnishes the maternal cell with a soul! "The maternal cell" he says, "is in many ways suggestive of that phenomenon that is called inorganic [*sic*] matter; while the paternal cell is equally suggestive of the life-giving principle called spirit." This brilliant discovery, betraying such a child-like innocence of all acquaintance with the rudiments of embryology or histology, is made the basis of his system, which, at whatever point examined, is found to be a superstructure as weak and worthless as its foundation. The work is an example, unfortunately becoming quite common, of a person who has had no scientific training, but has read in a desultory way a few important scientific works on subjects that bear on popular questions, and who, with scarcely any other preparation, has plunged at once into the deep waters of scientific speculation, where his flounderings, if perceived at all, only provoke a smile in those who really understand the situation.

April (?), 1888—Ætat. 46.

231. The Frequency of Coincidences

History.—This is a brief abstract of the paper read Feb. 26, 1887, before the Philosophical Society of Washington. I had no manuscript, but talked from accumulated notes. I have continued to make these notes, and could now easily write a volume on the subject.

Bulletin of the Philosophical Society of Washington, D. C., Vol. X, 1888, p. 8.

EVERY one is constantly meeting with coincidences in everyday life, but few ever take the trouble to record them. Mr. Ward had always been struck by their frequent occurrence and remarkable character, but until within about fifteen years had been content, as most people are, to allow them to pass with only a momentary expression of surprise. Certain comments upon them, however, which he had met with in the writings of Auguste Comte and Dr. George M. Beard had led him to take a wider view of their significance and to commence in the year 1875 the practice of jotting down in his note-book some of the more interesting and striking of them. In this way a large collection of instances had accumulated, a few of which were selected for presentation to the Society. These were read directly from his notes, without change of phraseology, in order to preserve their literal accuracy. Most of them were of a character which, according to the mathematical law of probabilities, would not occur again within any finite limitation of the events with which they were associated.

The only application which it was attempted to make of the facts was to point out their bearing upon the investigations which had been recently conducted by the British Society for Psychical Research, from which in Mr. Ward's opinion, unwarranted conclusions had been drawn, and which, he believed, received their true explanation only when the frequency of coincidences was fully recognized.

April, 1888—Ætat. 46.

232. Review of the Geological History of Plants. By Sir J. William Dawson, International Scientific Series, New York, 1888

History.—Written March 7-8, 1888. I first sent it to the *American Journal of Science* on the 8, and it was declined as too long for their review department. I then sent it to *Science* on the 24. It was also declined by that journal, and on the 27, I sent it to the *Naturalist*. I received the book from the author on February 23, and wrote the review as soon as I had read it.

The *American Naturalist*, Philadelphia, Vol. XXII, No. 256, April, 1888.
pp. 335-337.

April, 1888—Ætat. 46.

233. Special Weather Bulletin

History.—Written March 15, 1888. For several years (1884-1887) it had been my custom to study the daily weather map when it arrived in the middle of the day and prepare a forecast from it for the following day. This was telephoned by an assistant at the National Museum to the Geological Survey on F Street. The need for this arose out of the fact that the forecast printed on the map was for the day it arrived only, and this was well over before its arrival. I had always believed it possible to forecast with considerable accuracy for another day, and most of my forecasts were correct. These forecasts were all written on small slips of uniform size ($2\frac{1}{2} \times 4\frac{1}{2}$ inches), and preserved in my office. They were ultimately put into a box and appropriately labeled.

About the beginning of 1888, the War Department commenced placing the daily map in a frame at the front (north) door of the Museum building. Great numbers of visitors passed by and many would stop and study the map with interest. But the stiff technical language in which the forecasts were couched were not only more or less unintelligible to the public, but tended to confirm the popular notion that the Weather Bureau was a sort of oracular sanctuary, and to surround the whole matter with an air of mystery. I therefore conceived the idea, in addition to telephoning my second day forecast to the Geological Survey, of writing a somewhat longer one and pinning it to the map for the benefit of visitors. I headed it with the words: *Discussion of the Map*, then proceeded to say what the special conditions plotted on the map seemed to signify, and finally what would under ordinary circumstances be the result, especially for the general region about Washington. The special object was to make it educational, and to give the public to understand that the weather was a domain of law and natural causation. This plan had been followed for some time, and I had informed Professor Goode, Director of the National Museum, of my intention to do so, and I remember how heartily he approved of it. But on March 6, he sent me a letter he had received from Gen. A. W. Greely, Chief Signal Officer, U. S. Army, then in charge of the Weather Bureau, complaining of my bulletins pinned to the map, as discourteous to the Army Signal Office. I knew Gen. Greely personally, and at Professor Goode's request I wrote him a letter setting forth the motives that had prompted my action. He replied to me directly under date of March 12, and in quite an apologetic tone, thanking me for my interest in the subject, and offering to send me a special daily map for my own use in making the forecasts.

I consulted with Professor Goode and it was decided to have the whole matter officially recognized by the National Museum as a part of its educative functions, and to have a blank printed containing the part that belongs to all the forecasts and general suggestions to the public, and leaving blank space below for the special discussion arising each day. A wooden frame with a glass door was also provided to hang by the side of the frame containing the map.

This plan was kept up almost as long as I remained on the

staff of the Museum. The forecasts were removed each day and a new one substituted. Large numbers accumulated, and I preserved them. They were also boxed up and labeled and, unless destroyed since I left in 1906, the two boxes are still there. The Weather Bureau was long ago transferred to the Department of Agriculture, and placed in the hands of trained civilians, who have lopped off much of its stiff military character, but not much improvement in the method of phrasing the forecasts was made for several years. The plan of predicting for two days ahead was, however, adopted soon after the events above described. One of the forecasters, Mr. W. A. Glassford, came over and studied my forecasts. He then came to see me and expressed his strong approval of my more rational method, and he did all he could, when the forecasting devolved upon him, to cause the Bureau to follow it. I have a letter from him, dated Feb. 3, 1892, in answer to one I had written him, setting forth my reasons for the course I was pursuing, and in which he says:

"Yours of the 1st gave me much pleasure indeed. Such expressions serve as a stimulus to the work of forecasting in the line you agree with me is what the public want and what a weather forecast should be. Yours is the only recognition I have had. . . . I notice forecasts of other forecast officials are often omitted by the press, but mine are usually accorded full space. I have struggled along this line and only received faint support from some in authority, but I have faith in the ultimate recognition of predictions in the line you approve. I wish you would grant me the use of your note to the Chief, as I think showing it confidentially would please him."

This document can scarcely be said to have been "published," though it has been seen and read by thousands, but as it was "printed" it cannot well be excluded, and it is entitled to rank as one of the "Glimpses of the Cosmos."

SPECIAL WEATHER BULLETIN

For Washington, designed to cover the waking hours (sunrise to midnight)
of , 189 .

N. B.—The object of these weather bulletins is more especially to call attention of those consulting them to the *causes* of the changes that take place in the weather from day to day, and the *reasons* that exist for expecting the particular kind of weather which is said to be "indicated" by the data embraced in the Daily Weather Map of the Chief Signal Officer, by the side of

which this bulletin is posted. This map should be studied in connection with the bulletin, and it is hoped that in this way the interest in meteorology as a rational science may be somewhat increased, and the difficulties that attend the forecasting of the weather, even for a short period and with the best attainable data, may be better appreciated.

Date at which posted, , 189 .

Discussion of the Indications:

June 26, 1888—Ætat. 47.

234. What shall the Public Schools Teach?

History.—The long series of articles with the above title was inaugurated in the number of the *Forum* for January, 1888, the first one being from the pen of the Rev. Minot J. Savage of Boston. I read it on Jan. 3, and immediately wrote to Mr. Metcalf offering to contribute an article on the subject. He replied on the 7, intimating that he would like me to write an article on manual training. I agreed to do so, and he said he would like it by June 1. Prof. W. B. Powell, Superintendent of Schools, invited me to go around with him and visit the training schools of Washington, which I did on March 15. I also investigated the subject extensively in the libraries, read Leland and other books, and availed myself of Professor Powell's recent report on the subject, from which I quoted extensively. The article was written April 11, to May 8, 1888. The original part of it is that in which I emphasized the view I had long held and had expressed before,* that the inventive faculty can and should be regularly cultivated as an essential part of education. On the cover of the July number of the *Forum* containing this article my middle initial is misprinted H., for which Mr. Metcalf apologized when I called his attention to it.

The *Forum*, New York, Vol. V, No. 5, July, 1888, pp. 574-583.

INTELLIGENCE consists not only in knowing but also in knowing how. Widely as this truth has been recognized by educationalists ever since the advantages of popular education first began to be felt, it is only within a few years, comparatively speaking, that any practical application of it has been systematically attempted. But a new era has now begun,

* *Dynamic Sociology*, New York, 1883, Vol. II, p. 394.

and the ease with which industrial education can be conducted is only less surprising than the success that has attended its introduction. The educational world is almost unanimous for it in some form, but wide divergences exist not only as to the methods but even as to its true object. Different nations defend it on different grounds. Germany has led the way, apparently from a theoretical standpoint, as the logical outcome of its system of public instruction; but it has had the effect, perhaps unexpected, of placing German manufactures at the head of the European market, and giving them the preference over those of other countries. England has already taken the alarm, and appeals are being made for state aid in the establishing of industrial schools, which are openly demanded on economic grounds as the only means of saving the commercial prestige of Great Britain. A similar motive underlies one of the strongest considerations in their favor in this country, in the obvious fact that foreigners are successfully competing more and more for the first places in all our industrial establishments. It is felt that this is not due to any native inferiority in American artisans, but to insufficient and defective training. But fortunately thus far manual training has been chiefly defended, in this country, on grounds, which, if not always strictly theoretical, are at least legitimate, honorable, and philosophical. To attempt an adequate presentation of all these, while an easy task, would scarcely be profitable, in view of their recent thorough discussion at educational conventions and in the public press, and such is not the purpose of this article. Still, as some readers may not be familiar with these discussions, a brief enumeration of a few of the leading points may not be an unsuitable prelude to an article primarily devoted to the development of a single thought on the general subject.

In looking through the large mass of rapidly accumulating literature on manual training I find nothing that accomplishes this purpose so admirably as the brief summary of the principal claims of the new education contained in the latest report of Prof. W. B. Powell, superintendent of schools of the District of Columbia. He reduces them to eight distinct heads; and although each of these is set forth in very compact form, still the full presentation would occupy more space than can here be given to it, and a mere indication of the central idea in each will have to suffice. Prof. Powell's eight reasons for the introduction of manual training into the public schools are as follows:

1. To secure, amid the diverse pursuits of a great population, "that harmony of thought and action necessary to the peace and prosperity of the state.
2. To create a popular appreciation of the character and value of "mechanical appliances, industrial achievements, and art endowments."

3. To substitute skill and exactness for bungling and guess-work in all the practical pursuits of life.

4. To give range and diversity to tastes and abilities, for the purpose of securing adaptability to vicissitudes in life, and of offsetting modern tendencies toward the excessive division of labor and narrowness of vocation.

5. To provide a useful education for the large class who have little power of abstract mental application, but marked ingenuity and manipulative tact.

6. To check the tendency to overcrowd the professions and so-called genteel occupations, such as clerking, book-keeping, private teaching, etc., as well as to discourage such non-productive activities as speculating, stock-jobbing, money-lending, and even banking, shopkeeping, and redundant mercantile enterprise.

7. To enable those who are destined to settle the frontiers of the country to cope with the difficulties of pioneer life.

8. To provide, without loss of time, for the needed relief of the pupil's mind from too protracted mental application.

This enumeration might be extended not only by the addition of other independent considerations of co-ordinate rank, but also by the specification of subordinate ones suggested by a number of Superintendent Powell's formulas. Moreover, any one of these heads might form the basis for an article like the present one. Such, however, is not its object, but rather to present, in as strong a light as possible, the high educational value of the training of what may be called the "constructive powers."

It has been complained that such training is so practical as to become a substitute for apprenticeship, and that it should, therefore, be left to the individual, and not undertaken by the state. It is proposed to show that it can be defended from the most theoretical standpoint. It has been urged that such training merely cultivates the hands and other parts of the body, and is, therefore, in the nature of teaching a trade. It is proposed to show that, rightly understood, it is essentially a training of the mental faculties, and this in the direction of the most useful of all the objects to which the powers of the mind can be applied. I may, therefore, be justified in taking a somewhat higher ground than is customary in discussing this question, and in endeavoring to lay down a few principles of wide application and fundamental character, without which such a treatment as is proposed could not satisfactorily proceed.

Probably there is no subject that is less definitely understood, or more thoroughly misunderstood, by the general public, even the educated classes, than that of the true nature of civilization. Notions about it are vague, narrow in scope, and generally false in fact. The real causes of progress are deep and obscure. They are so masked by superficial apparent causes that civiliza-

tion becomes confounded with its concomitants and even with its products. Among such apparent causes may be mentioned government, religion, morality, literature, art, commerce, industry. Whether one or another of these great social factors, so intimately bound up with man's well-being, is regarded as the true cause of all progress will depend upon the education and habit of thought of the individual. Perhaps I cannot do better than to postulate at once my own definition of civilization, long ago formulated, and published in 1883, viz., that it consists in "the utilization of the materials and forces of nature."

It sometimes seems to me that in refining upon the blessings of education we forget altogether what knowledge is for. So far as the improvement of man's estate is concerned we know only in order to do. Knowledge unapplied is sterile. It is only fruitful when it makes two blades of grass grow where only one grew before, when it converts "raw material" into useful objects, or when it directs into some useful channel the forces of nature which were previously running to waste or doing injury to man. Except as a matter of pure culture, the mere satisfaction of an intellectual craving or of æsthetic taste, knowledge is literally useless unless thus vitalized by action. This is as true of that systematic knowledge called science as of the most empirical forms of knowledge. It is not pure science that has advanced the world. It is its myriad applications to human needs. Material civilization is not the product of what has been thought, but of what has been first thought and then done.

Acquisition of the knowledge of nature's laws is called discovery. Application of this knowledge to human uses is called invention. It was not Henry who gave us the electric telegraph, but Henry and Morse. Henry personified Knowledge—discovery; Morse personified Action—invention. Invention implies, first, an acquaintance with the natural phenomena and laws in question; secondly, the perception of the modifications of the attendant conditions necessary to produce the required beneficial effect; and thirdly, the successful performance of the mechanical operations involved in these modifications. None of these steps can be omitted. Invention is, therefore, a very complicated form of intellectual and physical action. But taken in its broadest sense, as here defined, it so transcends all other forms of activity in its importance to mankind as to justify the strongest efforts to cultivate and perfect it as a faculty. By virtue of it alone man is a progressive being, and without it he would have remained a savage, if, indeed, he could have reached even the state of a savage.

Now, what I maintain, and what the advocates of the new education ought to insist upon in the discussion of this question, is, that this exalted faculty of invention, both in its mental and its physical aspects—both as to mind and body, brain and muscle—

is susceptible of cultivation in the same manner and to the same degree as all other human faculties. The mind can be directed by appropriate training into habits of inventive thought. It can be habituated to look for possible utilities in all objects and phenomena that present themselves to the senses, and trained to embody these ideas in concrete forms and mechanisms. This is genuine invention. The process consists in forming a mental conception of a given utility, and then in working out the modifications necessary to realize it. It is true that this is now constantly done in the construction of all kinds of useful objects, labor-saving machines, and ingenious devices. But the great mistake lies in supposing that this state of things cannot or should not be increased. It can be increased by education to any desired degree, and such a degree can be conceived of as might relieve mankind of nearly all the drudgery that has now to be performed.

The greater part of this most useful of all forms of thought and action is now lost for want of opportunity. Education furnishes opportunity. The opportunities for the exercise of this faculty are constantly occurring to all, but for want of its cultivation they go unperceived. Only those who train this faculty perceive them. It is known that in recent times invention is becoming a sort of profession, to be followed by any one who may choose it, like engineering or architecture. No one claims that engineers, like poets, are born, not made. Neither are inventors; but in the one case, as in the other, they require a course of study and training. A few persons follow invention as a business. They devote their whole energies to working out possible improvements in all kinds of machines and in the thousands of manufactured objects in use by society, and they occasionally hit upon an entirely new practical conception. The field is unlimited, but the practical difficulties are great, and it would be easy to prove that invention not only cannot, but ought not, to take rank alongside of the other professions. The fact of its being so followed by a few is cited merely to show that the difficulty does not lie in the differences in natural capacity. Professional inventors are not by nature more ingenious than some others who have never invented anything. They may have fallen into that line of work by accident or by force of circumstances. The degree of ingenuity doubtless differs in different individuals as widely as other forms of genius; but, like other forms of genius, it is apt to reveal itself where least expected when an occasion is presented for its development. The power to perceive material utilities and successful methods of realizing them cannot be correlated with other faculties. Persons of great ability in other directions may have this faculty in a very limited degree. Others who are commonly rated as mentally deficient have been known to possess it in a highly

developed state. Therefore a system of education should be broad enough to call it out wherever it is found in a latent condition.

It is popularly supposed that great inventions spring full-fledged from a few great brains. This is a gross mistake. It is true that certain names are associated with most of the epoch-making inventions, but a study of their history always shows that there had been a series of antecedent steps leading up to them. Formerly it was more common for these useful modifications of nature to be thought out by educated men who had little or no direct contact with the particular art or craft with which they were connected. But nowadays, all inventions are in the nature of "improvements" upon pre-existing inventions, and are chiefly made by the mechanics or artisans of the higher grades, who are constantly using the original devices, and who, through an intimate acquaintance with these, eventually perceive how they may be improved. This is as it should be, and as artisans become more intelligent this class of inventions will increase. The one who works with a tool or runs a machine is obviously the proper person to suggest its improvement. Nothing but the stolid ignorance of the working-classes in the past has prevented this from having always been the chief mode of advancing the useful arts. And it is hoped that in the near future the artisan as well as the engineer may not only receive a good education in the hitherto accepted sense of the term, but may also have such a training of the eye and the hand as will enable him to perceive and to effect all possible reforms in his chosen field of labor. The idea that an educated man is too good to be a mechanic is fast losing its hold upon society. So long as only enough could be educated to fill the learned professions the need of cultivating the inventive powers was far less than now. The lawyer, the physician, the clergyman had comparatively little use for such a faculty. But already, and more and more each year, the boy who is educated at the public school is destined to pass the greater part of his life in the pursuit of some productive industry. Let the higher faculties be brought to bear upon such pursuits. Very few of the higher branches taught in the grammar and high-schools can directly help the artisan in his daily life and business, but everything that he is taught to do or to make will count toward his future efficiency. Especially will he be able to apply all the training he may have received in that art of arts of which we have been speaking, the detection and creation of utilities. Notwithstanding our boasts of inventive genius the thoughtful person is constantly annoyed by gross mechanical maladjustments. He can scarcely walk the street, or ride in a public conveyance, or sit in a private parlor, or use the utensils that are provided for performing any kind of work, or, indeed, transact any business of whatever

nature, without being made to feel how little comfort, convenience, accuracy, or dispatch has been studied in any of the operations of every-day life. To enumerate the many cases of this class that occur to me as I write would only be to give illustrations which would be paralleled at once in the mind of every reader. Everywhere we see the lack of thought directed to the improvement of our material surroundings. This is because the importance of improving those surroundings forms no part of the education which is given to the youth of the country.

In a practical course of instruction, which it is not the purpose here to outline, these final results must, of course, be reached by a graduated system of training, leading up from small beginnings through the simpler arts, especially those of drawing, modeling, stenciling, carving, decorating, etc. The dealing with materials must precede the dealing with forces. But they are fundamentally one, since the qualities of substances are the manifestations of natural forces on a reduced scale. But the very inertia of inelastic substances, like clay or *papier-maché*, furnishes a valuable discipline and fitting preparation for the subsequent study of elastic bodies, expansive fluids, and powerful natural agencies to be controlled and utilized. In either case what is most important to be taught is the formation of a mental image of the utility to be created. The designing of patterns and models is a simple form of invention involving the same intellectual process as is required to survey a railroad or construct a bridge. Just as the architect is superior to the carpenter, so design in the minor arts and invention in the major ones are superior in importance, as objects of education, to the mere manipulation required to materialize these ideal conceptions. Education should aim high. The purely theoretical, so long as it is true, is better than the merely practical. Much harm has been done by the so-called practical educationalists in advocating manual training on these narrow grounds, and still more harm has probably resulted from the attempt on the part of teachers to accomplish too special and definite ends. The broader the generalization upon which a system of education is based the more acceptable and effective it becomes. If the truth with which we started out, that civilization consists essentially in the practical subjugation of nature to man's uses through the adoption of more and more perfect devices for utilizing material substances and mechanical forces, could be popularly understood and believed, there would be no further need to plead for industrial education. Instead of an experiment grudgingly tried, it would at once be recognized as the true end of all education, to which all other forms of education would stand in the relation of means.

The world has moved by virtue of what has been done in it, and only indirectly by what has been known. The French

saying, "*Qu'est ce qu'une foi qui n'agit pas ?*" applies to a system of education which teaches to know and not to do. And it is no secret that a large part of what now passes for education, both of the lower and of the higher kind, is thus sterile. To give it results is to give it life, and the introduction of the element of work is literally breathing into a moribund system the breath of life. It could be defended, if upon no other ground, as the best means of indicating what the world ought to know. For art, in the last analysis, rests upon science. Even the most empirical art is not the outcome of chance, but of knowledge acquired through experience. And if we give to the term "utility" the breadth of meaning that properly belongs to it, no knowledge which cannot be utilized is worth conferring. This canon, even with the most liberal construction, would still sweep away a large amount of the current education, to which far more time and energy are devoted than would be consumed in reducing all the useful knowledge conferred to productive practice.

The word "training" seems to be admirably calculated to express the central thought in the new education. Nothing is more familiar than the immense difference between the trained and the untrained faculties. It is all the difference between "eyes and no eyes." Whatever one's practical interests require to be attended to, that will be observed with an accuracy and minuteness which often astonish the uninitiated. But the faculties are specialized, and each one sees only what concerns him. The scientific habit widens the scope of this minute observation, but not beyond the specialty of each investigator. Thus, the lumberman can accurately describe the bark and the wood of any tree with which he is acquainted, but if asked the shape of the leaf he can give no idea of it. The botanist can describe the whole tree, but he cannot tell by what insects it is infested. This the entomologist can do, although he can give but a vague account of the tree. It has been well said that, keen as are the senses of the North American Indians in observing nature, there never was an Indian who could distinguish the two dwarf willows of the White Mountains from each other. Animals are also close observers, but only of what specially interests them. In traveling through a country horses see only horses and dogs see only dogs, but these they see before men become aware of their presence. Wild animals are very knowing, but their acuteness is confined to the pursuit of subsistence and the escape from danger. In every case it is the result of training in the school of experience, in which, under certain circumstances, the intensity of perception may be made to approach those exalted hypnotic states in which the senses as well as the other faculties become capable of performing what seem to be miracles. And this sharpening of the human faculties may as well take place in the direction of perceiving utilities in the objects and phenomena

of nature as in the narrower fields above mentioned. The lumberman, the savage, the horse, the dog, and the wild animal observe those things, and no others, that are, from the standpoint of each, practical, and this sense of the practical constitutes a school in which these acute perceptions are trained. It is not radically different with the trained scientific specialist. He simply has an expanded conception of the practical, which in all cases is that which satisfies the demands of a being, whether those demands be low and simple or high and complex.

To those who can rise to the contemplation of society as a conscious organism of the highest and most complex character, and who understand what its progress consists in, as above defined, it must be obvious that the most eminently practical of all things is the subjugation of nature to man. Thus far this has been accomplished empirically, at hap-hazard, and, as it were, by accident. The educational training of the mind and hand together on a grand scale in the public schools, through the conscious action of nationalities throughout the civilized world, is the first effort ever made by society to lift the work of civilization out of the empirical groove and place it upon the high plane of systematic science. And if the movement continues, as there is every reason to believe it will continue, there is no cause to doubt that we shall see, upon a scale commensurate with civilization itself, all the difference which has ever attended the transfer of any human art from the stage of raw empiricism to that of organized science.

July, 1888—Ætat. 47.

235. Notice of Williamson's Memoir on the Organization of the Fossil Plants of the Coal Measures.—Part XIV. The True Fructification of Calamities. By W. C. Williamson

History.—Written May 29, 1888.

American Journal of Science, New Haven, Third Series, Vol. XXXVI [Whole Number CXXXVI], No. 211, July, 1888, pp. 71-72.

July, 1888—Ætat. 47.

236. Notice of the Memoir: Einleitung in die Paläophytologie vom botanischen Standpunkt aus. Bearbeitet von H. Grafen zu Solms-Laubach, Leipzig, 1887

History.—Written May 26–29, 1888.

Ibid., p. 72.

July, 1888—Ætat. 47.

237. True and False Civil Service Reform

History.—Written Oct. 8, to Nov. 6, 1887. Sent to the *Forum* Nov. 8, and returned on the 16. Mr. Metcalf said he was overdone with politics and economics. I then sent it at a venture to the *North American Review*, but it was promptly returned. I suppose I was a little discouraged, and I was very busy with other things that I regarded as more important. At any rate it seems that I made no further effort to get this article published, and allowed it to lie fallow. The following year an ephemeral journal called *The Historical American* was started in the West. It was organized and edited by an enterprising young man named Henry C. Long, of Cleveland, Ohio, who wrote to me on the first of May asking me to contribute an article to the first number. Knowing that I would get nothing for what I sent there, I looked among my rejected manuscripts and found this article, which I sent to him. After *The Historical American* had suspended,

Mr. Long, who was connected with several other journalistic enterprises, made an effort to have this article republished, and sent it to *Belford's Magazine*, of which Mr. Donn Piatt was editor. He promptly accepted it.

The *Historical American*, Columbus, Ohio, Vol. I, No. 1, July, 1888, pp. 25-30;
Belford's *Magazine*, Chicago, New York, and San Francisco, Vol. III,
No. 2 [14], pp. 202-210.

IT would be most presumptuous in any writer of this day to lay a straw athwart the great current of civil service reform. The demand for it is so nearly unanimous that no political party dares to oppose it, however much it may desire to do so, and the only dissenting voice ever heard is that of the disaffected office-seeker whose success is endangered by the safeguards it has established.

But may not some of the methods by which it is sought to bring this reform about be open to criticism? Is it not natural that, as in other good causes, some of the zeal displayed should be misdirected? As a matter of fact this movement is no exception to reform movements in general, which always demand some things that would defeat instead of advance the ends desired. As might have been expected, many of the chief advocates of civil service reform have been persons of little or no practical acquaintance with public affairs. They are, as a rule, outside observers of them, and draw their conclusions as to the conduct of government officials from current reports. Any one who has acquired a practical knowledge of such matters knows how wide these reports usually are of the truth and how crude and inaccurate popular ideas in relation to them are.

There is much said about the intelligence of the American people, especially in political affairs, but the fact is that they are densely ignorant of everything relating to the actual conduct of the government after the officers are chosen. They understand quite well the methods by which their representatives are elected and the subordinate appointments made, but their knowledge is confined almost exclusively to this. They have very little idea of what the officers have to do when selected. Many seem to suppose that their principal duty is to draw their salaries. They speak of the "spoils" of office, as though the idea of an equivalent in services had never entered their minds. Neither do they seem to have any conception of the legal restrictions to the appropriation of public funds. It is known that vast sums of money are collected by the government and that certain officers are intrusted with its safe keeping and expenditure. It is therefore natural, in the absence of any instruction as to how this is done, to suppose that the safety of the public funds

is dependent upon the integrity of these individual custodians. The dullest intellect cannot fail to perceive what a precarious condition of things this must be.

The cause of this gross popular ignorance upon these subjects, so vital to the interests of the state, is the want of all public instruction in practical politics, and of all sources from which such information can be obtained. Just as what is called history only tells about the making and unmaking of kings, neglecting the real activities of the peoples treated, so our political education, whether at school or at the town caucus, only teaches how the officers are put into their places, and neglects to inform us what they are put there to do.

In the prevalence of such crude conceptions it is no wonder that civil service reformers have addressed themselves almost exclusively to the individual instead of to the system, and should have grossly exaggerated the extent of the corruption that exists in national affairs. The whole trend of the movement has been in the direction of criminating individuals, imputing to them fraud, bribery, peculation, and all forms of malfeasance in office; the corollary being freely drawn that the government is perpetually sustaining corresponding losses. To have judged from the noise made on the occasion of the Star Route trial one would have supposed the entire revenues of the post-office department had for years been swallowed up by the enormous swindling operations of its officials, and it was a fitting commentary upon this illusion that it happened to be just at the close of that trial that the department found it necessary to recommend a reduction of the rates of postage to check the surplus of revenue.

In the eyes of certain civil service reformers every public officer is dishonest, and if intrusted with funds only awaits an opportunity to abscond. The general tone of the reform is to suppose a man guilty until proved innocent; or, rather, irrespective of evidence. For a charge is considered equivalent to conviction, and nothing is more striking to the judicial mind than the unanimity with which the organs of this class, after making such a charge, proceed thenceforward to argue as if it had been proved. Neither will they retract anything in case of acquittal after trial, but continue to reiterate the charge while condemning the jury.

As an example of this we may take the case of Mr. Alexander R. Shepherd, whom Washington has recently given a spontaneous ovation for having "made" the Capital of the country at the cost of his private fortune, but whom certain reform journals have never ceased to villify with the opprobrious epithet of "Boss Shepherd," and to class along with "Boss Tweed" as a type of the leaders of corrupt municipal rings.

Civil service reform has, with some people, become a mere shibboleth, or party cry, and they vie with one another as to who

shall manifest the most zeal. The savage ferocity with which an unfortunate office-holder is pounced upon when suspected of some slip in his official conduct is such that one cannot help experiencing a certain satisfaction on failure to sustain the accusations.

What, now, is the natural outcome of this state of things? It is surprising that all do not see how powerfully it must militate against all possible reform in the civil service. Its necessary effect can be no other than to lower the tone and quality of the service. It is as much as an honest man's reputation is worth to accept any position of trust under the government. The ease with which charges are made, the readiness with which they are believed, and the difficulty with which they are disproved, make the acceptance of office by any one who ought to hold it hazardous in the extreme. Those who, under such circumstances, can desire office almost demonstrate thereby their unfitness to hold it. Certain ones there are who see in the service of the government their clearest field of usefulness, and who brave the dangers incident to it, but they do so well knowing that they will be classed along with others whose motives are altogether different. Those who are most frequently heard to say that "a public office is a public trust" are the ones who are least willing to trust the public officer. This maxim should be given a meaning, and if it is ever expected to secure trustworthy officers they must be made to feel that they are really trusted.

I have said that the amount of official corruption and incompetency is exaggerated. I shall endeavor to make this more clear. What I wrote five years ago I see now no reason for qualifying:

"Statistics show that in the management of the finances the losses sustained in government transactions bear a less proportion to the sums handled than in private institutions. This is due to numerous causes, one of the chief of which is the absence of personal attachment and sympathy. In a national exchequer the teller or cashier expects to have his balances scrutinized, and he feels no humiliation in submitting to it. It is done by law, or by general regulation, as a regular part of the duties of the office. This is usually not the case in private institutions. Ties of friendship, often of relationship, require these precautions to be neglected through fear of seeming to suspect dishonesty, and thus, human nature being everywhere the same, fraud and embezzlement are of daily occurrence.

"It might similarly be shown that all the functions of government are usually performed with far greater thoroughness and fidelity than similar functions intrusted to private individuals. If any one will take the trouble to examine the various reports published by the several executive departments of any government and to compare them with efforts of a like general nature made by individuals, he will doubtless be willing to confess that the latter fall below the former in many important respects. The peculiar weight which everybody attaches to the word 'official' has something more to sustain it than the mere blind worship of great names. It is instinctively felt that, whether absolutely reliable or not, an official statement is the very most reliable to be attained; and between two statements, one official and the other unofficial, the strongest opponent of governmental encroachment on private territory would not hesitate to prefer the former."*

* "*Dynamic Sociology*," Vol. II., pp. 582-583.

Much more might be said in the same general direction. An investigation into the inner workings of any branch of the government would show that, with only the normal number of exceptions, it is conducted by capable and honest officers and employes who take a lively interest in their work. Wherever there is room for improving the system by which the work is done the needed reforms are introduced, and a glance at the history of such a system will enable one to trace its growth under intelligent management, usually from small beginnings and early crude methods, to perhaps some comprehensive scheme adapted to the wants of a great nation, with numerous ingenious devices for the saving of labor and the prevention of loss. A large amount of work is constantly being done which is not provided for by law, but which is seen to be needed or useful, and is prompted solely by a desire to improve the service. The spirit of economy is especially obvious. Instead of the squandering of public money and waste of public property usually imputed to government, we actually find it going too far in the direction of economy. Decisions rendered by Treasury officials affecting customs or internal revenues are always made in favor of the government as against the importer or manufacturer. Decisions of the Comptroller often amount to positive hardship to the accounting officer. Subordinates in the auditing bureaus manifest the greatest zeal in detecting irregularities in accounts and preventing fraud. They often seem to imagine that they are there to keep the money that an officer has advanced to the government from being refunded. The same spirit animates the Pension Office, where the policy seems to be to keep every applicant out of his pension as long as possible and permanently if possible; and this is constantly done on what are known to be mere technicalities.

Appropriations are always less than the estimates of the departments because there is a constant effort to enlarge the sphere of activity. The greatest economy is practiced in the several bureaus to make the appropriation go farther than the mere routine of the office would require. Current expenses are cut down to the minimum. Cheap furniture, instruments, and appliances are purchased. Uncarpeted floors, old rickety desks, and plain pine tables with chairs to correspond, are all we find in many important offices. Cheap stationery is doled out in limited quantities, and such a use of it for private purposes as any private establishment would be ashamed to interdict is looked upon as theft. An intelligent man who had spent some time attending to a little business with the government in Washington, once said to me that the thing that most impressed him was to see *how poor the government was*. He had found most important business being transacted by capable men in the attic of an old rented building that ought to be condemned

as unsafe. Every one of similar experience has seen the same thing.

The agents who travel for the government are not allowed as much as they would be by any respectable private firm and must economize carefully to prevent personal loss, still they will higggle with those they have to deal with in a manner that they would be ashamed of if they were doing business for themselves.

Every department, as already remarked, is always striving to enlarge its own jurisdiction, thus manifesting a willingness to assume additional duties. Only a few years ago no less than three departments were each claiming to be the only proper one to conduct a Geological Survey, and still later the same has been true for the Coast and Geodetic Survey and for the Weather Bureau.

These and many other facts totally disprove the oft-made claim that only individual interest, based on the hope of gain and the fear of loss, can secure the efficient management of any branch of business. It has been demonstrated that salaried officers display fully as much interest, zeal, and energy as if their income depended upon their success. But here there is this difference: that in private enterprise, where that income is the sole motive to action, the success aimed at is limited to securing that income, and all other factors are neglected, whereas with the public servant the success aimed at is a creditable result. Hence, in the former case this latter aim is only indirectly, and often only imperfectly, secured. Government does all its work well because it has no personal end to subserve. It is only in private enterprise, under the spur of personal gain, that we have the shoddies and adulterations so characteristic of all trade. The leaders of the civil service reform movement are, as a rule, uninformed upon these subjects about which they profess to instruct the people, and the people are consequently misinformed as to the services and the character of the officers and employés of the government. Not only are they in the main able and industrious, but they are honest and scrupulous in the discharge of their duties. There is no wide-spread corruption, incompetency, or sinecurism in the public service. Special cases might no doubt be discovered, but certainly not more nor worse than prevail everywhere in private life.

But even if there were gross abuses in the administration of public affairs, even if important losses were thereby sustained, the correction of these abuses and the prevention of these losses would still by no means be the chief reason for civil service reform. The remedy for these evils is not to assail the character of individuals nor to establish an inquisitorial espionage over the conduct of every public officer, but so to perfect the system of administration as to make the safety of the public funds and public property as nearly as possible independent of individual char-

acter. These evils, incident to the nature of man and the imperfections of the system, only produce a trifling ripple upon the public mind and an inappreciable effect upon the national finances. But there is an evil, remediable by true civil service reform, which affects in the most powerful manner all the vital issues of the country. This is the recognition of the question of holding office as a political issue. It is not using too strong language to characterize this as political debauchery. It confounds interest with principle, destroys the honesty of political conviction, and makes every election mean something else than the actual opinion of the majority upon the legitimate issues. The great majority of voters, who, were there no distorting influences, would be honestly guided by their actual convictions, will let very small personal advantages outweigh these. Great moral questions have a strong hold upon but comparatively few. In this competing world it is about all any one can do to meet his most pressing physical necessities. As against these the highest principles have little influence upon conduct. Nor is this such a discouraging fact as many suppose. It is the condition upon which the race has developed. If men had not always put their own interests first they could never have overcome the obstacles to their existence which they have had to encounter. The day of self interest has not yet passed, and he who to-day will sacrifice his personal good to an abstract principle of ethics not enforced by law is justly regarded as partially insane. Yet it is nothing less than this that is demanded of the voter when he is asked to vote according to his principles when this conflicts with his interests. The man who believes that the election of a particular candidate will secure him or a member of his family a lucrative position will not long consider the objections to that candidate or the obnoxious principles which he or his party represents.

In one sense it is impossible to separate interest from principle. Most political principles aim at interest. All proposed measures affecting the revenue are accepted or rejected from their supposed influence upon taxation, and hence upon the pecuniary interests of the voter. So with questions affecting labor, commerce, transportation, banking, and most other human activities. But such interests are legitimate. They represent the welfare of society. Not so the question whether this or that man, or the adherents of this or that political party, shall hold office. This is an interest confined to a comparatively few individuals. To all others it is a matter of absolute indifference. There is, moreover, no equity involved, for there is no more justice in giving office to one person than to any other equally fitted for it. Yet, in view of the uncertainties that exist, the hope of securing it affects very many. The desire to reward political friends increases this number, and the dependents in each case again

greatly widen the vicious circle. Add to this that the office seekers are in most cases those who take a leading part in shaping local politics, and thus wield an undue influence, and we have a faint idea of the extent of this evil.

The man who is interested in the distribution of patronage does not know whether he is a Democrat or a Republican; whether he favors protection or free trade, hard or soft money, prohibition or license; whether his sympathies are with labor or capital, with the debtor or the creditor class; or whether or not he would have the government control the telegraph or regulate the railroads. Or if he knows how he stands on any of these questions it is not his convictions that determine his vote. His political conscience is completely debauched by the introduction of an utterly illegitimate issue, of no interest to the country at large, but appealing so powerfully to his personal interest as to override and set at naught all legitimate considerations. It is safe to say that, since the subsidence of the great war issues, there has not been an election in this country in which it is certain that the true sentiment of the majority has been correctly expressed upon a single legitimate question.

It is here that the reform is needed. By the side of this great national demoralization the peccadillos of office holders sink into insignificance. The corruption that needs to be investigated is not that of a few subordinate officials but that of the whole voting population. Unless the present tendencies are checked there is danger that all great questions of human rights, as well as the business interests of the country, may be seriously neglected, and American politics degraded into a disgraceful scramble for office. But here again the cause does not lie in a low state of public morals, but solely in a corrupt system. The American people have shown the power of disinterested moral sentiment in casting off slavery, and they are now, under the spur of the same sentiment, waging a crusade against intemperance and other social evils. The moral tone of our society is not below that of the most advanced nations of Europe. The office seeking curse has already been recognized and marked for destruction, but as yet the true method has been discerned by but few. *It consists in the removal of all inducement to office seeking.* The non-elective offices must cease to be in the remotest degree a reward of political action and be filled by some such proper process as will secure a thorough and efficient service. What this process should be it is not within the purview of the present article specifically to point out, but I may call attention, as some indication of the direction that this question may yet take, to the proposition of Prof. Herbert B. Adams, of Johns Hopkins University, to establish a civil academy for the proper training of candidates for office in the duties of administration and the general principles of governmental operations.

As among the leading steps toward a true civil service reform may be set down the following:

1. The complete removal of the non-elective offices from political control, so that neither the hope of gaining nor the fear of losing office can have the slightest influence upon the mind of the voter.

2. The establishment of a system for the transaction of public business which shall, as far as possible, be self-protective by automatically preventing the perpetration of fraud. This is in a great degree already accomplished in the requiring of bonds and the regular inspection of balances, and only needs to be brought to greater perfection.

3. The reposing of confidence in public officers and protecting them from calumny, while at the same time holding them to a strict accountability, thus rendering it possible for good men to accept office and impossible for bad ones to profit by it.

4. The inauguration of a national system of instruction in the science and art of government, and the diffusion in the most liberal manner of correct information relative to the methods by which the public business is transacted, and the nature and magnitude of governmental operations. The civil service academy should form a part of this last named system, and might well be a special "school" of the great national university recommended by Washington, Adams, Jefferson, and Madison, and more recently by Secretary Lamar.

Each of these true reforms the people have a right to demand as something affecting their personal interests as well as the safety of the country, and it is in this direction, and not in that of any political party, that they should resolutely move.

July, 1888—Ætat. 47.

238. Dabny's Sensualistic Philosophy*

History.—Written March 18, 1888. The journal *Public Opinion* had sent me this book for review. I wrote this notice and sent it, but it was declined, and properly, on the ground that the province of that journal was to reflect the views of authors, not to criticise them. As I did not care to write that kind of a review of this book, I laid the article aside, and when Mr. Long wanted matter for his new magazine I sent it to him on May 7.

The *Historical American*, Columbus, Ohio, Vol. I, No. 1, July, 1888, p. 78

August, 1888—Ætat. 47.

239. Evidence of the Fossil Plants as to the Age of the Potomac Formation†

History.—Written April 4-14, 1888. I had been studying the Potomac formation since 1885 and had become greatly interested in it. Professor Marsh, then president of the National Academy of Sciences, had been working up a collection of bones from it collected in Maryland, and he had come to the conclusion that the formation was Jurassic. I had always regarded it as Lower Cretaceous, but the plants from its lowest beds were peculiar, and my mind was open on the subject. On Jan. 20, Major Powell telephoned me that Professor Marsh was

* *The Sensualistic Philosophy of the Nineteenth Century*, considered by Robert L. Dabney, D.D., LL.D., &c. New and enlarged edition. New York: Anson D. F. Randolph & Co.

† Read before the National Academy of Sciences at Washington, April 20, 1888.

in his office and desired to meet me. I went over and had an extended interview with Professor Marsh on this subject, at the close of which he invited me to prepare a paper to be read before the Academy, promising to introduce me, as I was not a member. As it was Professor Fontaine who had worked up the Potomac flora, I felt that he was the proper person to prepare the paper, and on Feb. 16, I wrote him a full statement of my interview with Professor Marsh, and asked him to write the paper. He declined to do so, but urged me to comply and to use his manuscripts and drawings freely for the purpose. These were then in my hands in preparation for the press. I laid the correspondence before the Director, and he virtually ordered me to go ahead and prepare the paper. I worked the entire month of March preparing tables of distribution of the Potomac flora, and these were ultimately embodied in Fontaine's work on the subject, greatly increasing its value. From these, when finished, I prepared my paper. It was read before the Academy on April 20. Major Powell presented me in a complimentary speech, and I was attentively listened to. I sent it to the *American Journal of Science* the following day and it was of course promptly accepted. It is difficult to say whether I regarded this or my invitation to the Herbert Spencer banquet (see supra, Vol. III., No. 137, pp. 112-117) as the higher honor. They were too unlike for comparison.

American Journal of Science, New Haven, Third Series, Vol. XXXVI [Whole number CXXXVI], No. 212, August, 1888, pp. 119-131.

August, 1888—Ætat. 47.

240. Asa Gray and Darwinism. An Address delivered at the Gray Memorial Meeting of the Botanical Section of the Biological Society of Washington, April 5, 1888

History.—Written March 22, to April 4, 1888. Delivered April 5. Rewritten May 11–17. Dr. Gray's death occurred on Jan. 30, 1888. The other speakers at the Memorial Meeting were Prof. J. W. Chickering, Dr. George Vasey, and Prof. C. V. Riley. Professor Langley presided. Mr. Walter Deane of Cambridge published an excellent sketch of Dr. Gray in the *Torrey Botanical Bulletin*, with a fine portrait. He sent the sketch to me and I asked his permission to use the portrait, which he granted, and I sent it to Mr. Long, who wrote to the *Torrey Botanical Club* and obtained a copy and used it as the frontispiece to the article. The copy is unfortunately very inferior to the original.

The *Historical American*, Columbus, Ohio, Vol. I, No. 2, August, 1888, pp. 85–92, plate.

THE men who contribute to the advancement of any great truth may be divided into two classes: those on the one hand who, as avowed adherents, openly advocate it with all its logical consequences, and those, on the other hand, who only partially embrace it, and who, while declaring themselves ready to accept as much of it as can be proved, fearlessly criticise it and cautiously resist its extension to wider fields of thought.

This has been specially marked in the progress of the modern

ideas of development in the organic world, where, at the outset, the unqualified acceptance and logical application of the new doctrines seemed subversive of all religion, and were believed by some to be incompatible with sound morality.

It is well known that the greater part of that wild storm of opposition which Mr. Darwin's views at first met with emanated from persons who had no direct acquaintance with Darwin's works, and who based their attacks almost entirely upon the statements of his ardent disciples. These latter, belonging to the first of the classes above enumerated, announced the general results, mostly unsupported by the facts so laboriously collected by Darwin, and did not hesitate to extend his reasoning to, if not beyond, its most extreme logical conclusions.

While, therefore, this zealous vanguard of science may have done good service in accustoming the public mind not merely to Darwin's views but also to certain far-reaching inferences which naturally flow from them, this good was certainly far more than overbalanced by the shock which so naked a presentation of so unwelcome a truth necessarily produced. One can almost conceive of the *Origin of Species*, falling as still-born upon the world, in consequence of this state of things, as did the *Zoölogical Philosophy* of Lamarck, expressing so nearly the same truth, fifty years earlier.

What was most needed in this juncture was the cautious and conservative criticism of the theory, entirely upon its own merits, by persons of admitted competency in a fair and liberal spirit, and without the least tendency to fly off into remote realms or to impinge upon the long settled moral and religious convictions of the age. Such enlightened critics Mr. Darwin certainly had, both in Europe and in this country. Looking at the subject from this point of view, history will doubtless fully bear out the statement that, whether we look to England or the United States, no man has done as much to remove apprehension from, and inspire respect for, Darwinism, and therefore really to help on its triumphal march, as the modest American botanist, Dr. Asa Gray. Wherever it was known that Asa Gray saw nothing sinister, nothing dangerous, in the teachings of Darwin, those teachings were stripped of all their terrors. The impossibility that such a man, so eminent in science, so clear in his conceptions, so pure in his morals, and so steadfast in his faith, could pass judgment upon a work that he had not thoroughly examined, or favor a doctrine that could be productive of evil, was apparent to all who knew him, and to the full extent of Dr. Gray's wide influence throughout the world the works of Charles Darwin were stricken from the index expurgatory and admitted into the family circle as safe books for all to read.

The correspondence between Darwin and Gray began in

1855. They had previously met at Kew, while the latter was abroad on one of his tours of visiting European herbaria, and taking advantage of this slight acquaintance, Darwin addressed a letter to him on the twenty-fifth of April, 1855, informing him, among other things, that he had been for several years collecting facts on variation in animals, and requesting some information on the same subject in relation to plants. This letter was responded to on the twenty-second of May, and thus began a friendly interchange of ideas between the two men which lasted until Darwin's death. Among the letters that passed between them perhaps the most important was the one dated September 5, 1857, in which the future author of the *Origin of Species* acquainted Dr. Gray with the precise nature of his great discovery, now known as the law of "natural selection." It so happened that this letter was published at the same time as was the brief epitome of the *Origin of Species*, prepared by Darwin at the urgent solicitation of his friends, to appear simultaneously with the remarkable essay of Mr. Alfred Russel Wallace *On the Tendency of Varieties to Depart Indefinitely from the Original Type*. These three papers, preceded by an explanatory letter signed by Sir Charles Lyell and Sir J. D. Hooker, occupying altogether only eighteen pages in the *Journal of the Linnæan Society for 1858*, constitute the first matter ever published in relation to natural selection, and are, therefore, the *fons et origo* of the greatest revolution that has ever taken place in human thought. But before they saw the light of public scrutiny the letter had crossed the Atlantic, and Asa Gray became the godfather, as it were, of this giant idea which has conquered the scientific world and made an epoch.

Naturally a conservative man, Dr. Gray was not rash in accepting the new theory, although in one of his early letters (January 23, 1860), he remarks: "The moment I understood your premises I felt sure that you had a real foundation to hold on. Well, if one admits your premises, I do not see how he is to stop short of your conclusions, as a probable hypothesis at least."

On December 14, 1858, and January 11, 1859, Dr. Gray read an elaborate paper before the American Academy of Arts and Sciences, on "Diagnostic Characters of New Species of Phænogamous Plants Collected in Japan by Charles Wright," at the close of which he introduced certain important generalizations relative to the geographical distribution of plants in the northern hemisphere. This paper was published in the *Memoirs of the Academy* in 1859, and in a foot-note on page 443 he alludes to the papers of Darwin and Wallace in the Linnæan Journal and says:

"The views there suggested must bear a prominent part in future investigations into the distribution and probable origin of species. It will hardly be doubted that the tendencies and causes indicated are really operative; the question is as to the extent of their operation. But I am already disposed,

on these and other grounds, to admit that what are termed closely related species may in many cases be lineal descendants from a pristine stock, just as domesticated races are; or, in other words, that the limits in occasional variation in species (if by them we mean primordial forms), are wider than is generally supposed, and that derivative forms may be as constantly reproduced as their originals."

Thus early and plainly did Dr. Gray speak on this momentous issue, placing himself in full line with what was soon to be the current of advanced scientific thought. It is remarkable that up to that time no Englishman, not even Lyell, Hooker, nor Huxley, who had been acquainted with Darwin's views since 1844, had appeared to comprehend their import so clearly, or had spoken so unequivocally upon the subject.

The *Origin of Species* appeared in 1859 and was immediately reviewed at length by Dr. Gray in the *American Journal of Science*. That review is a remarkable paper and made a profound impression upon the scientific mind of that day. It is chiefly devoted to an exposition of Mr. Darwin's theory, and not to any great extent, to a defense of it, but this only shows his sagacity in perceiving that this attitude was the best possible, and would have been even for one who most completely accepted that theory and desired its acceptance by others. For open advocacy at that time would have provoked opposition and deterred many readers, whereas, in this case perhaps more than in any other, the most successful way to stifle opposition and remove apprehension was to induce people to look into the merits of the subject. The theory is so extremely reasonable, and the facts marshalled in support of it by Darwin so abundant, that the candid reader can scarcely resist the conclusions at which he arrives.

That this consideration, and not any serious doubts as to the truth of the fundamental principle of natural selection, was the true reason that moved Dr. Gray to adopt the expositional method in reviewing the *Origin of Species* appears in a letter which he wrote to Darwin soon after its publication. He says in this letter:

"It naturally happens that my review of your book does not exhibit anything like the full force of the impression the book has made upon me. Under the circumstances, I suppose I do your theory more good here by bespeaking for it a fair and favorable consideration, and by standing non-committed as to its full conclusions, than I should if I announced myself a convert; nor could I say the latter with truth."

But one of the greatest services rendered by this review was in the opportunity it afforded to its writer to attack and demolish a theory which had been proposed only a short time before by Prof. Louis Agassiz in his *Essay on Classification*, to which Mr. Darwin's views were diametrically opposed. This theory, it

need hardly be said, was Agassiz's favorite notion that the floras and faunas of the world were all created where we find them ("autochthonous"), so that not only the families and genera but the same species, where found in different parts of the globe, are of distinct and independent origin and parentage. The Darwinian theory, it is true, goes to the opposite extreme and not only predicates, as did Linnæus, the lineal descent of all the individuals of the same species, wherever they may occur, from common ancestors, but makes the further sweeping claim that the different species of the same genus, and even the genera of the same family, have also all descended from common ancestors, increasing in remoteness as we pass from lower to higher groups. Dr. Gray had already touched upon this question in the memoir above referred to on the flora of Japan, but now he meets the issue squarely and places in a clear light the superior claims of the Darwinian over the Agassizian theory.

This review was followed up by a long series of articles, lectures, and addresses on subjects involving more or less directly the discussion of the new doctrine, in all of which are to be seen the most searching penetration, the most admirable candor, and the most charming temper, combined with a judicious conservatism, diplomatic caution, and due respect for those opinions with which so many feared these doctrines were incompatible. Although primarily a botanist, and in no proper sense a zoölogist, it is safe to say that there was no man in this country, or perhaps in England, who better understood, not merely the general scope and philosophic import, but even the finer details and special modes of illustration of the new principle. This is not merely an individual judgment, but that of all who are acquainted with his writings. Darwin himself confessed it in the most unequivocal way. In a letter to Gray, dated September 10, 1860, after reading his admirable article in the *Atlantic Monthly*, under the title of "Natural Selection Not Inconsistent with Natural Theology," he says:

"You will be weary of my praise, but it does strike me as quite admirably argued, and so well and pleasantly written. I said in a former letter that you were a lawyer, but I made a gross mistake. I am sure that you are a poet. No, by Jove, I will tell you what you are, a hybrid, a complex cross of lawyer, poet, naturalist and theologian! Was there ever such a monster seen before?"

In another letter, dated September 26, 1860, he says: "You never touch the subject without making it clearer. I look at it as even more extraordinary that you never say a word or use an epithet which does not fully express my meaning. Now Lyell, Hooker, and others, who perfectly understand my book, yet sometimes use expressions to which I demur." And in still another he says: "I declare that you know my book as well as

I do myself and bring to the question new lines of illustration and argument in a manner which excites my astonishment and almost my envy. As Hooker lately said in a note to me, you are, more than any one else, the thorough master of the subject." It would be easy to multiply testimony to the same effect.

Only a few of Dr. Gray's contributions to Darwinian literature can be specially mentioned here. The September number of the *American Journal of Science* contained a dialogue between "D. T." and "A. G.," which brings out in the clearest manner his view of the bearing of Darwin's theory on the doctrine of design. The articles in the *Atlantic Monthly* for July and August, 1860, under the title already given, still further enlarged upon this view and considered the whole question from the standpoint of natural theology. A third article in the October number of the same magazine on "Darwin and his Reviewers," is devoted to replying, at considerable length, and with his characteristic force, to a number of the most important adverse criticisms that had appeared up to that time. Most of these were anonymous, appearing in the *North American Review*, the *Christian Examiner*, the *Edinburgh Review*, the *North British Review*, etc., but besides these there was one by M. Pictet in the *Bibliothèque universelle* of Geneva, and one by Agassiz in the *American Journal of Science*. These were the principal, but by no means the only, contributions of Dr. Gray to this subject during the first two years that followed the appearance of the *Origin of Species*, and which were directed to expounding and defending the general doctrine of Natural Selection as formulated in that work; and occasional other articles of similar import were published during the next six or eight years.

Twelve years elapsed between the appearance of the *Origin of Species* and that of the *Descent of Man*, in which interval Darwin had published several other works, including the large one on *Variation in Animals and Plants under Domestication*. Many of those who had accepted the doctrine of natural selection as applied to the lower animals had denied its applicability to the human race, and these insisted that Darwin would never allow such a use to be made of it. Others took the opposite view, and said there was no stopping short of the admission that man was subject to this law. Professor Ernst Haeckel, of Jena, in the introduction to his *Generelle Morphologie*, published in 1866, and in his *Schöpfungsgeschichte*, in 1868, boldly asserted this, and was severely taken to task therefor, as "out-Darwining Darwin." The *Descent of Man*, of course, silenced this clamor, and in his autobiography Darwin says: "As soon as I had become, in the year 1837 or 1838, convinced that species were mutable productions, I could not avoid the belief that man must come under the same law"; and in proof of the common remark that his omission of all allusion to the human race in his *Origin of*

Species was dictated by shrewd policy, he here further remarks: "It would have been useless and injurious to the success of the book to have paraded, without giving any evidence, my conviction with respect to his origin."

In view of all this, it is of the greatest interest to know how so eminently conservative a critic as Dr. Gray would receive this severe test of his fidelity to Darwinian principles. He was not one of those who had denied the applicability of the law of natural selection to the human species, and therefore he had nothing to take back. For him to have enthusiastically accepted the new extension of that law would have been contrary to his well known habit of mind as well as to the scientific habit in general. While there is nothing to show that he specially welcomed it, there is equally nothing to show that he was at all surprised at it. Everything indicates that it was nothing more than he had expected, and that he regarded it as perfectly logical and the necessary outcome of the Darwinian philosophy. There are even indications that it had long been settled in his own mind. Agassiz had carried his autochthonous theory so far as to declare that all of the distinct races of men were separately created on the spot where they were first known to dwell, and that the relationships between them were "intellectual" only. In Gray's original review of the *Origin of Species*, to which reference has been made, he seems to have this in mind when he says: "The human races, upon this [Darwin's] view, likewise may or may not be species according to the notions of each naturalist as to what differences are specific, but, if not species already, those races that last long enough are sure to become so. It is only a question of time." He began an article in the *New York Nation* of October 16, 1873, on "The Attitude of Working Naturalists toward Darwinism," by a favorable notice of Alphonse De Candolle's *Histoire des sciences et des savants depuis deux siècles, suivie d'autres études sur des sujets scientifiques, en particulier sur la selection dans l'espèce humaine*, which is largely devoted to the discussion of natural selection in its application to the human race, ably defending and reinforcing Darwin's views. In another article in the same journal for January 15, 1874, on "Evolution and Theology," he is obviously less favorable to the views of Hodge, Henslow and Wallace, who in their several writings were disposed to take man out, to a certain extent, from the influence of natural selection. Nowhere, so far as I can learn, has Dr. Gray said even as much as this, or been known to swerve from a full and honest acceptance of every legitimate conclusion from that great law.

Most of the papers thus far mentioned, together with a number of others which space will not warrant mentioning here, were collected into a volume, and published in 1877, under the title *Darwiniana*. The concluding essay of this volume on "Evolu-

tionary Teleology" was here published for the first time. This title indicates as clearly as any single expression can do, the attitude of Dr. Gray toward the general subject, which was, after all, not far different from that of Darwin himself. Roughly stated, it was that the adaptations in the organic world as brought about by natural selection, are not, and in a wisely ordained universe, ought not to be the product of specific design in each individual case, and that the various purposes for which organs are so adapted must be distinguished from the purposes for which conscious and intelligent beings adapt means to ends, so that in this sense there may be purpose without design, and ends of being not thought out or foreordained except as parts of a comprehensive plan or scheme of nature. And it is forcibly argued that such a well-ordered world as can continue without constant interference reflects greater credit upon its author than would a world that required the perpetual and omnipresent agency of its inventor.

That he did not regard the acceptance of such views as in the least inconsistent with the belief in a God or the practice of Christianity is not only evident from his writings and his exemplary character, but was expressly stated by him in the famous passage of the preface to *Darwiniana* which says:

"As to the natural theological questions which are here throughout brought into what most naturalists, and some other readers, may deem undue prominence, there are many who may be interested to know how these increasingly prevalent views and their tendencies are regarded by one who is scientifically, and in his own fashion, a Darwinian, philosophically a convinced Deist, and religiously an acceptor of the 'creed commonly called the Nicene' as the exponent of Christian faith."

It would have been to the present writer a pleasant and a grateful task, had there been space, to draw especial attention to the numerous and interesting ways in which Dr. Gray actually utilized Darwinism as a safe working hypothesis in botany, where he admitted its application to be most difficult; for, not only in accounting for the origin and distribution of species and of floras, but equally in accounting for the presence and forms of the organs of flowers, the great law of "descent with modification" was his constant and faithful handmaid.

He had a strong penchant for the treatment of the broader problems of the vegetable kingdom, which he had shown in several of his earlier papers, especially in those relating to the statistics of the flora of the Eastern States, published in the *American Journal of Science* in 1856—as fine a piece of botanical arithmetic as ever was produced. Still more strongly was this bent of his mind shown in the memoir already mentioned on the flora of Japan, a large part of which is devoted to the questions, thus early attacked by him, of the geographical distribution of plants

and their migration during the post-tertiary period. But his great classic on this subject was his admirable address on the history of Sequoia, the genus to which both the California redwood (*Sequoia sempervirens*) and the "great trees" (*S. gigantea*) belong, and of which they are the sole living representatives. This address was delivered by him as retiring president of the American Association for the Advancement of Science at Du-buque, in August, 1872. His beautiful simile in the introduction, drawn from his own beloved science, in which he likens the president of the association to a biennial plant which flourishes for the year in which it comes into existence, performing its appropriate functions, but when the second year comes round is expected to blossom out and disappear, would have been complete if he had added that after blossoming the biennial plant bears its fruit, thus expanding and perpetuating its usefulness. Certainly no labor that Dr. Gray ever performed for science was more fruitful in its results than his biennial blossoming out on this occasion. Written, as he himself confessed, on board the train while traveling across the continent and out of reach of books or herbarium facilities, his address was nevertheless replete with facts and appropriate illustrations from every department of science. Permeated, as he then was, with Darwinian principles, Dr. Gray never employed that all-embracing hypothesis with greater effect than in this superb effort. Fresh from the land of the great trees that made his theme, which he had then visited for the first time, the brilliant faculties of his mind were heightened by enthusiasm, and his utterances became, as it were, inspired. Although in possession of scarcely any of the abundant facts of paleontology now known in support of his views, he saw with unerring ken and portrayed with a precision which has defied subsequent criticism, all the steps in the weary pilgrimage of these giant denizens of the Sierras, as they were driven southward by the advancing ice sheet, or lured northward by the return of the cosmical summer, only to be again thrust back by the wintry blast, and again tempted to resume their northward march; and he saw how, in this protracted and unequal struggle with the elements, this grand race of beings, without losing anything of its dignity or majesty, had been gradually decimated in number and circumscribed in habitat, until, in the present epoch of the earth's geological history, we find it on the verge of extinction, although still, in the grandeur of its individual survivors, asserting its undisputed claim to be monarch of the vegetable kingdom.

Equally firm was his grasp of the Darwinian law in its application to the facts of vegetable morphology. He reviewed all of Darwin's botanical works as fast as they appeared—the *Fertilization of Orchids*, *Climbing Plants*, *Insectivorous Plants*, *Cross and Self Fertilization*, *Forms of Flowers*, *Power of Movement in Plants*,

—and always with ability and due recognition of their great value to his own chosen field of research. The proofs of insect agency were at once accepted and were widely extended by his own comprehensive knowledge in that department. He saw, as all must soon see, that in the flower form is the language by which it speaks to us and tells us the story of its life. He saw that there is an historic correlation of flowers and insects, and though he may not have distinctly enunciated the great truth which paleontology teaches, that color, form, and fragrance are simply adaptations through natural selection to the growth of an entomological environment, so that insects may literally be regarded as the cause of flowers, *pari passu* with which they are proved to have developed, still in many passages of his writings it is evident that he possessed in his mind a distinct adumbration of this truth.

Dr. Gray was, as he says, a Darwinian “after his own fashion.” That mild gentility and discriminating delicacy which characterized everything else in his nature also characterized his philosophy. Nothing that shocked or jarred upon the refined ear of the most highly organized type of manhood found favor with him. The austere logic of Herbert Spencer, he said was “not to his liking,” and similarly, anything that threatened to overthrow time-honored customs or systems was looked upon with distrust. It was this peculiarity of his mind that caused him to cling to the end of his life to the so-called natural system of classification in botany founded by Jussieu. Dr. Gray had come upon the stage of American botany early enough to assist in the revolution through which that system had been made to supplant the comparatively artificial system of Linnæus, and all his text-books and teaching during a long life had been devoted to enforcing and popularizing this, at that time, great reform in systematic botany. Nevertheless this system, especially as regards the position of the Gymnosperms, had really been overthrown for twenty years, not only by the facts of paleontology, which botanists may perhaps be excused for not properly weighing, but by those of morphology and physiology, so abundantly brought out by the German histological school, since Darwin had shown them how to use this class of facts. Every step in the transition from the Cryptogam to the Conifer had long been pointed out and the conclusion over and over again drawn that the latter must be the direct lineal descendant of the former. In fact so obvious had this become, and so generally had the conclusion been accepted, that his own disciples and most ardent admirers, Messrs. Coulter and Barnes, in their work on the *Rocky Mountain Flora*, prepared under his immediate eye and issued in uniform style with his own books, so as to lead many to suppose him responsible for all it contained, were unable in 1885 to resist the march of scientific opinion on

this point, and broke away from the old classification, adopting the new.

As one of the first* to call the attention of the botanists of this country to the need of this reform, and one who has never let an opportunity pass to insist upon its importance as a step in the direction of a true natural system of botany as great as the one already taken, I have deemed it not in bad grace for me to offer this defense of Dr. Gray's attitude on this question, which to many has seemed to involve a great inconsistency. It certainly was too much to expect that a man would, in the last years of his work, favor the overthrow or radical modification of the very system he helped to establish and by which the successful labors of his whole life had constantly been guided.

Appropos of this branch of my subject, I cannot perhaps better conclude than by recalling my last personal interview with Dr. Gray. He paid me a friendly call at the National Museum, his step as nimble, his eye as bright, and his face as beaming and joyous as when I first saw him. With a characteristic brevity of purely conventional talk, he almost immediately brought up a living subject, and, as it happened, it was none other than this very question of the natural succession of vegetable types. And I well remember the particular illustration he used of imperfect angiospermy in a dicotyledonous plant,† by which he sought to convince me that the transition from Cryptogams to Phænogams might as well have taken place through the Dicotyledons as through the Gymnosperms; and how I tried to show him that it was a case of analogy and not of homology; how pleased he seemed when I would score a point against him, and how playfully he would again rally to the attack. And when he finally tripped away as blithely and happily as he came, I recall my reflection upon his complete faith in the ultimate triumph of scientific truth, and my heightened admiration for a man whose comprehensive knowledge and philosophic grasp of principles were only exceeded by the childlike simplicity of his manner and the spotless purity of his life.

* See *The American Naturalist* for June, 1878, p. 359.

† *Rheum australe*. See Baillon, *Bullet. du Congrès international de Bot. et d'Hort.* St. Petersburg, Mai 1884, pl. iii., figs. 1-11.

October, 26, 1888—Ætat. 47.

241. Our Better Halves

History.—Written Sept. 9-26, 1888. The history of this article is given in *Pure Sociology*, pp. 297-298, and what is said there need not be repeated here. It was the practice of the Six O'Clock Club to include in the announcement of any dinner a report of the proceedings of the preceding one. Thus the announcement of the Fifteenth Dinner to take place on May 24, 1888, contained the following report of the Fourteenth Dinner, April 26, 1888:

"The fourteenth dinner, like all those to which ladies are invited, was numerously attended, about seventy being present.

"Commissioner Webb gracefully gesticulated with the gavel, and Professor Lester F. Ward deftly led the debate of the Sex-Equality question into entertaining paths.

"Among scientists present, with ladies, were Professor Lester F. Ward, Professor Frank Baker, Professor G. K. Gilbert, Professor W. H. Dall, Professor S. S. Packard, Professor H. W. Wiley, Professor Davidson, Mr. W. H. Michael, and Professor C. V. Riley; and to these may be added Senator and Mrs. Manderson, Gov. N. J. Colman, Dr. Featherstonhaugh, Commissioner Benton J. Hall, General Van Vliet, Mrs. Elizabeth Cady Stanton, Miss Phebe Couzins, Ex-United States Marshal for Missouri; Mrs. Belva Lockwood, Professor and Mrs. Spencer, and Mrs. N. P. Willis, the widow of the famous poet.

"Most of these participated actively, the naturalists, geologists, botanists, biologists and entomologists coming out strongly, each in his own specialty, like the gentlemen at the Lodgers' dinner.

"The Secretary cannot do better than to quote from the *Critic's* report that some of these 'showed how the male, at first insignificant and apparently a later creation, had developed and grown to a position of equality by the side of his female partner; how this had resulted from natural and especially from sexual selection—the female always choosing for her companion the handsomest and strongest; how the female of some species is 10,000 times larger than the male, and how, in other cases, he is a mere minute parasite whom she

carries about as a part of her baggage; how, under the influence of preference, the males of mammals and of birds have risen to physical superiority to their mates till the lion is finer and stronger than the lioness, the bull larger than the cow, the peacock adorned with a gorgeous tail, with which to excite the admiration of the pea-hen, and the turkey cock gifted with a self-important strut and arrogant gobble.

“Their inference was that whatever man is he has been made, through millions of years of sexual preference, by the female of his own species and the anthropoid and other species from which he has sprung, and that it would be unfair for him to kick down the ladder by which he has climbed.”

I do not know who the “*Critic*” was who reported the speeches, but, whoever he was, barring a few crudities, and allowing for the humor which was common to the whole proceedings and especially characterized my own part in them, he may be credited with having fairly represented the view I sought to present. The ideas are wholly my own, and he seems to have entirely ignored all the other speakers.

The exact title of the subject for discussion was: *What has Science to say about the Equality of the Sexes and the Future of Woman?* I both opened and closed the discussion and maintained the humorous vein throughout. I spoke mostly from notes or mere catch-words, but the first part of my opening remarks was written out and I have preserved the manuscript with the loss of the first folio. As this of course was never published, and probably never will be, I will give a few samples of it here.

“It is safe to assume that there is no one here present to-night who is so ignorant as not to know that there was once a time when we were all apes. Most of you are probably aware that at a still earlier period we were barnacles, at least all who possess a backbone; and the curious thing about this is that it is the young barnacle that has the backbone, which it loses as it arrives at maturity, a tendency which I have observed to have been inherited by some men.

“Well, it is possible in this age of science to go much farther back in human history, and I find it necessary to do this in order to treat this question properly. Now I presume you all believe in the transmigration of souls, a truth taught by Thales and Pythagoras, Brahma and Buddha, and confirmed by modern science and modern theosophy. In scientific phrase this law is called *phylogeny*, which must not be confounded with *philogyny*, of which I shall have nothing to say; nor shall I speak of philanthropy, nor philandry, much less of their opposites, misanthropy, misogyny, and misandry, for the last of which terms the synonym Miss Anthony is now in common use.

“This phylogeny of modern science is simply the metempsychosis of the ancients, only there has been so great progress that we now know through just

what forms we have passed in reaching our present estate. A careful study of this, the only true history of the race, shows that, while there have been some fluctuations, it has consisted upon the whole in a prolonged struggle on the part of man to escape the tyranny of woman. Throughout all the earlier stages of this prolonged transition period man has been the complete slave of woman and under the most abject bondage to her. I can give only a few illustrations. For instance there was a time in our history (I am speaking only to gentlemen now) when we were of scarcely any account at all. As compared to our female companions we were utterly insignificant in size. There was one stage when we went by the name of Sphæularians, in which the women (I speak metaphorically, you know) were several thousand times as big as the men, and when we got along to the arachnoid or spider stage they were still several hundred times as large as we. And it is related that whenever a wife got tired of her husband or got out of patience with him for any shortcoming, instead of going into a court, as they do now, and getting a divorce, or sending to another State for one, she would simply eat him up at a single mouthful and go and get another one, who had to share the same fate.

"When we were bees we were called drones and treated with the utmost contempt by our wives, who called themselves queens, and as mayflies or ephemerae we were not allowed to take any nourishment, and had no mouths, teeth, nor stomachs for the purpose. Hence we could only enjoy the society of our wives for a single day and die of starvation.

"When we finally got a little backbone and became successively fish, and frogs, and snakes, we fared a little better, but even as birds we were sometimes subjected to great indignities, such as that of the American ostrich, where the gentleman is required to sit upon and hatch out the eggs and rear the brood while the lady goes to the polls.

"But it was in this bird stage that a great principle came to our aid. The women (I still speak metaphorically) became so capricious and fastidious that they would have nothing to do with men unless they had some peculiarity that they imagined to be pretty, some wattle, or crest of feathers, some bright, gaudy color, long handsome tail feathers that they could spread out and strut round with, or strong beaks or spurs that they could fight with. Then they picked out the biggest and strongest, the ones that could whip all the rest, and none but these large, powerful, handsome fellows could get anywhere near a woman (still speaking metaphorically). These predominant qualities were thus transmitted to the progeny and a race of these picked men was thus produced. The same mania prevailed throughout the quadrupedal stage, and our male ancestors acquired great strength, size, and fighting powers, so that if they had known enough they might have easily whipped out their female oppressors and assumed the mastery. But they were generally content to fight each other so as to show off before the women and curry favor with them.

"But bye and bye the women got somewhat higher ideas and commenced picking for the smartest fellows as well as for the best looking. Ah! what a mistake! Slavery is incompatible with intelligence, and cunning was soon used as a means of throwing off the yoke. Brains were also transmitted, and they predominated in male heads according to the law that confined antlers, tusks, and spurs to that sex, and at some point in this history I have been recording

woman was compelled to surrender her scepter into the hands of man. I leave it to the ethnologists to tell you how he has retaliated for the long abuse he had been subjected to, and will only note that just as the selection by the women of the finest husbands made a race of strong and handsome men, so a new selection on the part of the men of the most beautiful wives has made a race of beautiful women.

"And they say that history repeats itself. I see a tendency on the part of men to select smart as well as handsome wives. Beware of that step. Already the note of discontent has risen from the heirs of this tendency, and we have seen within the past month [the reference was to the Woman Suffrage Convention recently held in Washington] an indication of what the result of this suicidal policy will be. The symptoms are alarming, and the movement must be put down. I appeal to all men to awake to the danger, and realizing that in union there is strength, to unite—with the women!"

Several others made humorous speeches. I remember the conclusion of Dr. Wiley's, which was about in these words. "Any man who believes that woman is a delusion ought to be made to hug that delusion to the end of his life."

On August 26, I wrote to Mr. Metcalf and sent him the titles of several articles that I thought I might write during the fall and winter for the *Forum*. Among them was that of *Our Better Halves*. That was the first one he asked for and he did this at once (August 30). I commenced almost immediately to write the article. The rest is known to the reader. The article attracted some attention. *Public Opinion* for Nov. 4, condensed it, Mrs. Christine Ladd Franklin made it the basis for an editorial in the *Nation* for November 15, and it was copied entire in *Foote's Health Monthly* for March, 1889.

On March 13, 1889, Mr. Metcalf wrote me saying: "Grant Allen sends all the way from Italy a reply to your *Better Halves*, and begs so hard for a place in the interest of the other side of the question, that I shall have to give it to him." His article appeared in the *Forum* for May, 1889 (Vol. VII, pp. 258-263) under the title: *Woman's Place in Nature*. Mrs. Christine Ladd Franklin asked me to help her prepare a short reply to it for the New York *Nation*, and I spent considerable time between May 4, and May 9, collecting data for her. I wrote out the result in an article of ten pages of manuscript and sent it to her. Her article appeared under the head of *Notes* in the number for June 6, 1889, on pages 469-470, making somewhat more than a column in two paragraphs. The last sentence is certainly hers.

The first one may be. The body of the article is probably substantially what I sent her, but somewhat cut down, and perhaps slightly altered. She returned my notes on May 27, but they are not preserved, so that I cannot compare them.

I had 200 reprints of the article struck off, and I distributed them free to all askers. I gave 50 copies at one time to the Woman Suffragists.

The Forum, New York, Vol. VI, No. 3, November, 1888, pp. 266-275.

THE practice of calling women better than men is purely chivalric—an empty compliment to the sex. The less enlightened regard them as inferior. The more enlightened consider them equal when all elements are taken into the account. The general opinion is that they are superior morally and inferior mentally and physically. But there are so many kinds of moral, mental, and physical qualities that each of these classes, when carefully analyzed, is found to contain some elements in which the one and some in which the other sex stands higher. It is therefore a difficult problem, increasing in intricacy with more thorough and candid investigation. Attempts have been made, often with much success, to point out the leading characteristics in which the sexes differ, especially in mental traits, and some have gone deeper and sought to explain these differences as arising from physical and social conditions.

It is not my purpose to treat the subject from this standpoint, nor to attempt in any way to show wherein superiority consists. I propose simply to predicate of the female sex a particular kind of superiority and to offer some proofs on this single point. Whatever may be woman's present condition in civilized, barbaric, or savage society, and whatever may be the condition of the female sex in the different departments of animal life, I shall undertake to contend that in the economy of organic nature the female sex is the primary, and the male a secondary element. If this be a law, its application to the human race is readily made and its importance to social life cannot be ignored.

That such a view should be looked upon as unsound, and even absurd, by those who have only studied men is quite natural, but one would suppose that close students of nature, particularly such as have chosen the world of life as their special field of research, would pause at this question and seek to give it such a final solution as to prevent its return into the arena of discussion. I am sorry to say that they have not done so. In fact, so far as I have observed, they have treated it from the most superficial standpoint. Writers of this class have frequently drawn important practical conclusions from what I hope to show to be

mere half-truths—conclusions bearing upon the future education, treatment, and position of woman in society. A quotation or two from authors of repute will make this point clear. Thus, in an article entitled “The Woman’s Rights Question Considered from a Biological Point of View,” in the *Quarterly Journal of Science* for October, 1878, the writer says:

“We purpose, therefore, to examine this question in the light of the principles of natural selection, of differentiation and specialization, and to inquire whether the relations of the sexes in the human species and the distribution of their respective functions are or are not in general harmony with what is observed in that portion of the animal kingdom which lies nearest to man; to wit, in Mammalia. . . . Even a very superficial and popular survey of the class Mammalia will satisfy us that the structural differences between the males and the females of each species are by no means confined to the reproductive organs. The male ruminant, whale, bat, elephant, rodent, carnivore, or ape, is on the average a larger and heavier animal than his mate. The tiger, for instance, exceeds the tigress in size by a proportion of from ten to twenty per cent. In few, if any, species is the superior stature of the male more striking than in the one which approaches man most nearly in its physical development—the gorilla. But the mere difference in size is not all; the female is scarcely in any normal case a mere miniature copy of the male. Her proportions differ; the head and the thorax are relatively smaller, the pelvis broader, the bones slighter, the muscles less powerful. The male in many cases possesses offensive weapons which in the female are wanting. In illustration we need only to refer to the tusks of the elephant and the boar, and the horns of many species of deer. On the contrary, there is no instance of a female possessing any weapon which is not also found, to at least an equal degree, in the male. Further, the superior size of the head in the male is not merely due to the more massive osseous growth needful for the support of tusks, horns, etc., but to a proportionately larger development of brain.”

And after much more in the same strain, this writer concludes:

“We have, therefore, in fine, full ground for maintaining that the ‘woman’s rights movement’ is an attempt to rear, by a process of ‘unnatural selection,’ a race of monstrosities—hostile alike to men, to normal women, to human society, and to the future development of our race.”

Prof. W. K. Brooks, in a very able article in the *Popular Science Monthly* for June and July, 1879, succeeded, as I think, in proving that the well-known passivity of the female sex has the important significance that it represents the principle of heredity, or permanence of type, the male representing that of variability; thus completely reversing the *varium et mutabile semper fœmina*. But notwithstanding his lucid conceptions on this point, Prof. Brooks felt called upon in this article to write:

“Our conclusions have a strong leaning to the conservative or old-fashioned view of the subject—to what many will call the ‘male’ view of women. The positions which women already occupy in society and the duties which they perform are, in the main, what they should be if our view is correct; and any attempt to improve the condition of women by ignoring or obliterating the intellectual differences between them and men must result in disaster to the race, and the obstruction of that progress and improvement which the history

of the past shows to be in store for both men and women in the future. So far as human life in this world is concerned, there can be no improvement which is not accomplished in accordance with the laws of nature; and, if it is a natural law that the parts which the sexes perform in the natural evolution of the race are complementary to each other, we cannot hope to accomplish anything by working in opposition to the natural method."

Utterances similar to those above quoted have constantly found place for the last twenty years in our best scientific literature, and it may be fairly said to be the fashion among scientific men to treat the woman question from this point of view. A great array of evidence is brought to show that woman is physically inferior to man, that she is smaller in stature, and that her brain is not only absolutely smaller, but is smaller in proportion to her body; that she has less strength in proportion to her size, less power of endurance, and a greater number of ailments. This, it is said, is the natural result of her sex. Reproduction is so great a drain upon the female system that we should expect it to be attended with diminished strength and vitality. It is further argued that the smaller and weaker females of animals, as well as the young, are protected by the larger and stronger males, and the inference is freely drawn that the dependence of the females among animals is similar to that of women in society, which latter is therefore the natural condition.

I shall not deny the fact of woman's physical and mental inferiority, nor shall I deny that the differences are, in the main, due to causes analogous to those which have differentiated the sexes of the higher animals. I must, however, deny *in toto* that these causes are what they are assumed by these writers to be. It has always surprised me that those who start out avowedly from a Darwinian standpoint should so quickly abandon it and proceed to argue from pre-Darwinian premises. It was Darwin who taught us why the boar has tusks, the stag antlers, and the peacock gaudy tail-feathers. It is because the females chose mates that possessed these characters. The characters selected by the females have been, in the main, those that tended to insure success in rivalry for mates. The greater size and strength of the males, together with their powerful weapons, have not been acquired, as is implied in the argument above stated, for the purpose of protecting the dependent females; they have been acquired entirely for the purpose of combating rivals and winning mates. In very few such animals do the males ever attempt to protect the females, even where the latter have their young to take care of. When the hen with her brood of chickens is attacked, it is not the cock that ruffs his feathers and defends them with his spurs; it is the mother herself that defends them. The cock is always found with hens that have no chickens, and only uses his spurs in fighting with other cocks that have no notion of injuring the females. In the entire animal kingdom the cases

where the male uses his great powers to protect the female or the young, or to bring them food, are so rare that where they are observed they are recorded as curious approximations to the social state of man. These "secondary sexual characters," as Darwin has named them, are generally adapted to aggressive warfare, not with the enemies of the species, but with the males of the same species for the possession of the females. All this has positively no analogy with the human condition, and those who cite these facts as a justification for retaining woman in a lower sphere of either mental or physical activity than that occupied by man, abandon the modern and correct interpretation of them and fall back upon the old interpretation which has been proved to be false.

That secondary sexual characters exist in man is, indeed, true. His beard is clearly one of the purely ornamental ones. His larger size and greater strength were doubtless acquired before his moral faculties had awakened, and are the result of his battles for his wives. The predominance of the male brain in the human species doubtless partakes of this nature, and is in a large degree attributable to this cause. The time came in the development of the race when brute force began to give way to sagacity, and the first use to which this growing power was put was that of circumventing rivals for female favor. Brain grew with effort, and like the other organs that are so strangely developed through this cause, it began to be more especially characteristic of the sex. The weaker sex admired success then as now, and the bright-witted became the successful ones, while the dull failed to transmit their dullness. There was a survival of the cunning.

The first use of mental power, as of physical power, was to defeat rivals and secure mates; it was not to protect female frailty or supply food to offspring. The females protected themselves and their progeny by maternal instinct. The females of all wild animals are more dangerous to encounter than the males, especially when they have young; and it has been observed that the male carnivores rarely attack man.

Nor do I deny that these agencies of selection are still at work, slowly, it is true, but perhaps as rapidly as at any previous period, producing physical modifications in man. But it is no longer simple female selection of male qualities, as in the lower animals; there is now going on an opposite class of influences by which a true male selection is bringing about modifications in woman, and this had progressed so far at the beginning of the historic period that the ornamental characters had been, as it were, transferred from the male to the female, and beauty, which in birds and many animals is the exclusive attribute of the males, had become the leading attribute of the women of the higher races. And while setting down this fact, let me call attention to its great significance as pointing to future possibilities in

woman when men shall learn to select other qualities in their companions than mere beauty; for under the power of this comparatively modern male selection woman may become whatever man shall desire her to be, and the ideal woman, however high the standard, will become more and more the real woman.

The entire argument of those who would restrict woman's sphere because she is mentally and physically inferior to man would therefore fall to the ground, even if we were to admit that there was something in her sex that rendered that inferiority natural and essential. To be fully consistent, it would be necessary to insist that woman should defend both herself and her offspring from hostile influences of all kinds, and also assume the whole duty of supplying her children with food, while the sole function of man should be, as it is in most mammals and birds, to take care of himself and fight off rivals. This would be the "natural" state of society in the sense in which these philosophers employ that term. It is only distantly approached in a few of the very lowest tribes of savages.

But let us now inquire what grounds there are for accepting this mental and physical inferiority of women as something inherent in the nature of things. Is it really true that the larger part taken by the female in the work of reproduction necessarily impairs her strength, dwarfs her proportions, and renders her a physically inferior and dependent being? In most human races it may be admitted that women are less stalwart than men, although all the stories of Amazonian tribes are not mere fictions. It is also true, as has been insisted upon, that the males of most mammals and birds exceed the females in size and strength, and often differ from them greatly in appearance. But this is by no means always the case. The fable of the hedgehog that won the race with the hare by cunningly stationing Mrs. Hedgehog at the other end of the course, instructed to claim the stakes, is founded upon an exception which has many parallels. Among birds there are cases in which the rule is reversed. There are some entire families, as for example the hawks, in which the females exceed the males. If we go further down the scale, however, we find this attribute of male superiority to disappear almost entirely throughout the reptiles and amphibians, with a decided leaning toward female supremacy; and in the fishes, where male rivalry does not exist, the female, as every fisherman knows, is almost invariably the heavier game.

But it is not until we go below the vertebrate series and contemplate the invertebrate and vegetable worlds that we really begin to find the data for a philosophical study of the meaning of sex. It has been frequently remarked that the laws governing the higher forms of life can be rightly comprehended only by an acquaintance with the lower and more formative types of being. In no problem is this more true than in that of sex.

In studying this problem it is found that there is a great world of life that wholly antedates the appearance of sex—the world of asexual life—nor is the passage from the sexless to the distinctly male and female definite and abrupt. Between them occur parthenogenesis or virgin reproduction, hermaphroditism, in which the male being consists simply of an organ, and parasitic males, of which we shall presently speak, while the other devices of nature for perpetuating life are innumerable and infinitely varied. But so far as sex can be predicated of these beings, they must all be regarded as female. The asexual parent must be contemplated as, to all intents and purposes, maternal. The parthenogenetic aphid or shrimp is in all essential respects a mother. The hermaphrodite creature, whatever else it may be, is also necessarily a female. Following these states come the numberless cases in which the female form continues to constitute the type of life, the insignificant male appearing to be a mere afterthought.

The vegetable kingdom, except in its very lowest stages, affords comparatively few pointed illustrations of this truth. The strange behavior of the hemp plant, in which, as has long been known, the female plants crowd out the male plants by overshadowing them as soon as they have been fertilized by the latter, used to be frequently commented upon as a perverse anomaly in nature. Now it is correctly interpreted as an expression of the general law that the primary purpose of the male sex is to enable the female, or type form, to reproduce, after performing which function the male form is useless and a mere cumberer of the ground. But the hemp plant is by no means alone in possessing this peculiarity. I could enumerate several pretty well known species that have a somewhat similar habit. I will mention only one, the common cud-weed, or everlasting (*Antennaria plantaginifolia*), which, unlike the hemp, has colonies of males separate from the females, and these male plants are small and shortlived. Long after their flowering stalks have disappeared the female plants continue to grow, and they become large and thrifty herbs lasting until frost.

In the animal kingdom below the vertebrates female superiority is well-nigh universal. In the few cases where it does not occur it is generally found that the males combat each other, after the manner of the higher animals, for the possession of the females. The cases that I shall name are such as all are familiar with. The only new thing in their presentation is their application to the point at issue.

The superiority of the queen bee over the drone is only a well-known illustration of a condition which, with the usual variations and exceptions, is common to a great natural order of insects. The only mosquito that the unscientific world knows is the female mosquito. The male mosquito is a frail and harmless little creature that swarms with the females in the early season

and passes away when his work is done. There are many insects of which the males possess no organs of nutrition in the imago state, their duties during their ephemeral existence being confined to what the Germans call the *Minnedienst*. Such is the life of many male moths and butterflies. But much greater inequalities are often found. I should, perhaps, apologize for citing the familiar case of spiders, in some species of which the miniature lover is often seized and devoured during his courtship by the gigantic object of his affections. Something similar, I learn, sometimes occurs with the mantis or "praying insect."

Merely mentioning the extreme case of *Sphærolaria*, in which the female is several thousand times as large as the male, I may surely be permitted to introduce the barnacle, since it is one of the creatures upon which Prof. Brooks lays considerable stress in the article to which I have referred. Not being myself a zoölogist, I am only too happy to quote him. He says:

"Among the barnacles there are a few species the males and females of which differ remarkably. The female is an ordinary barnacle, with all the peculiarities of the group fully developed, while the male is a small parasite upon the body of the female, and is so different from the female of its own species, and from all ordinary barnacles, that no one would ever recognize in the adult male any affinity whatever to its closest allies."

The barnacle, or cirripede, is the creature which Mr. Darwin so long studied, and from which he learned so many lessons leading up to his grand generalizations. In a letter to Sir Charles Lyell, dated September 14, 1849, he recounts some of his discoveries while engaged in this study. Having learned that most cirripedes, but not all, were hermaphrodite, he remarks:

"The other day I got a curious case of a unisexual instead of hermaphrodite cirripede, in which the female had the common cirripedal character, and in two valves of her shell had two little pockets in each of which she kept a little husband. I do not know of any other case where a female invariably has two husbands. I have one still odder fact, common to several species, namely, that though they are hermaphrodite, they have small additional, or, as I call them, complemental males. One specimen, itself hermaphrodite, had no less than seven of these complemental males attached to it."

Prof. Brooks brings forward facts of this class to demonstrate that the male is the variable sex, while the female is comparatively stable. However much we may doubt his further conclusion that variability rather than supplementary procreative power was the primary purpose of the separate male principle, we must, it would seem, concede that variability and adaptability are the distinguishing characteristics of the male sex everywhere, as the transmitting power and permanence of type are those of the female. But this is a very different thing from saying that the female sex is incapable of progress, or that man is destined to develop indefinitely, leaving woman constantly farther and farther

in the rear. Does the class of philosophers to which reference has been made look forward to a time when woman shall become as insignificant an object compared to man as the male spider is compared to the female? This would be the logical outcome of their argument if based upon the relative variability of the male sex.

We have now seen that, whether we contemplate the higher animals, among which male superiority prevails, or the lower forms, among which female superiority prevails, the argument from biology that the existing relations between the sexes in the human race are precisely what nature intended them to be, that they ought not to be disturbed and cannot be improved, leads, when carried to its logical conclusion, to a palpable absurdity. But have we, then, profited nothing by the thoughtful contemplation of the subject from these two points of view? Those who rightly interpret the facts cannot avoid learning a most important lesson from each of these lines of inquiry. From the first the truth comes clearly forth that the relations of the sexes among the higher animals are widely abnormal, warped, and strained by a long line of curious influences, chiefly psychic, which are incident to the development of animal organisms under the competitive principle that prevails throughout nature. From the second comes now into full view the still more important truth with which we first set out, that the female sex is primary in point both of origin and of importance in the history and economy of organic life. And as life is the highest product of nature and human life the highest type of life, it follows that the grandest fact in nature is woman.

But we have learned even more than this, that which is certainly of more practical value. We have learned how to carry forward the progress of developments so far advanced by the unconscious agencies of nature. Accepting evolution as we must, recognizing heredity as the distinctive attribute of the female sex, it becomes clear that it must be from the steady advance of woman rather than from the uncertain fluctuations of man that the sure and solid progress of the future is to come. The attempt to move the whole race forward by elevating only the sex that represents the principle of instability has long enough been tried. The many cases of superior men the sons of superior mothers, coupled with the many more cases of degenerate sons of superior sires, have taught us over and over again that the way to civilize the race is to civilize woman. And now, thanks to science, we see why this is so. Woman is the unchanging trunk of the great genealogic tree; while man, with all his vaunted superiority, is but a branch, a grafted scion, as it were, whose acquired qualities die with the individual, while those of woman are handed on to futurity. Woman is the race, and the race can be raised up only as she is raised up. There is no fixed rule by which Nature

has intended that one sex should excel the other, any more than there is any fixed point beyond which either cannot further develop. Nature has no intentions, and evolution has no limits. True science teaches that the elevation of woman is the only sure road to the evolution of man.

November, 1888—Ætat. 47.

242. Notice of Nya Anmärkningarna om Williamsonia of A. G. Nathorst.—(Ofversigt of Kongl. Vetenskaps-Akademiens Förhandlingar, June, 1888, No. 6.)

History.—Written Oct. 11, 1888.

The American Journal of Science, New Haven, Conn., Third Series, Vol. XXXVI [Whole Number, CXXXVI], No. 215, November, 1888, p. 391.

January (?), 1889—Ætat. 47.

243. Report on the Department of Fossil Plants in the U. S. National Museum for the year ending June 30, 1886

History.—Written in July, 1886.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1886, Part II, Washington, 1889, p. 231.

January (?), 1889—Ætat. 47.

244. Report on the Department of Recent Plants in the U. S. National Museum for the year ending June 30, 1886

History.—Written in July, 1886.

Ibid., pp. 233-235.

January 12, 1889—Ætat. 47.

245. The Paleontologic History of the Genus *Platanus*

History.—Written Nov. 24, to Dec. 13, 1887. The title originally given to the article was *The Pedigree of the Sycamore*. It was illustrated by a number of figures of fossil and living leaves. On Dec. 15, I sent it to the *Popular Science Monthly*, but it was returned on Jan. 26, 1888, with a letter from E. L. Youmans, saying that it was too technical for that magazine, and that the illustrations would be too expensive. On Feb. 13, I offered it to the U. S. National Museum, to be published in its proceedings as a contribution from a member of the staff. As these are published by the Government the process is very slow, and it did not appear till the beginning of 1889. Meanwhile I decided to use it as a paper to be read before the Biological Section of the American Association for the Advancement of Science at its meeting in Cleveland in 1888, and I read it there on Aug. 16. I withdrew the drawings long enough to have lantern slides made from them, and the paper was illustrated by projecting them on the screen. An abstract only was published in the *Proceedings of the Association*.

The history of this paper as above given is a very inadequate account of my work on this genus. It began much earlier. In studying Lesquereux's "Sassafras" leaves from the Dakota Group, I became satisfied almost from the first that they did not belong to Sassafras, and I soon became convinced that in these and his *Aspidiophyllum* we had to do, not indeed, with the genus *Platanus*, but with its Cretaceous ancestor. I had been collecting evidence on this point for a number of years, and on Feb. 20, 1886, I read a paper on *The Plane Tree and its Ancestors*

before the Biological Society of Washington. In this I exhibited specimens and showed the Society Lesquereux's figures as published in his *Cretaceous Flora*. Soon after I had my draftsmen prepare a few drawings. I then proceeded to reduce my paper to writing, and on March 5, 1886, I sent it to *Science*. But that journal rarely published illustrations, and could not use the article. I then sent it to the *American Naturalist*. Dr. Packard was then the editor, but he was about to retire, and the article was misplaced and remained lost for many months. When Professor Cope undertook to edit the *Naturalist*, and I informed him of the facts. I had given up all hope of finding the article, and rewrote it and had new and better drawings made. It is this new article with which we have here to do. At last on March 26, 1890, Professor Cope informed me that the article had been found. He wanted to publish it, but as it had already been published in better form, I asked him to return the manuscript and drawings, which he did, and I still possess them. But by that time new facts had come to light, and I was anxious to supplement the first paper. So I promised him another, and in due time wrote it and sent it to him.

Proceedings of the U. S. National Museum, Washington, D. C., Vol. XI, 1888, pp. 39-42, pl. xvii-xxii.

January 25, 1889—Ætat. 47.

246. American Weather*

History.—Written Nov. 29, 1888. Professor Goode brought me the book on Nov. 13, 1888, and asked me to review it for the *Epoch*.

The *Epoch*, New York, Vol. IV, No. 103, January 25, 1889, p. 463.

**American Weather*. A popular exposition of the phenomena of the weather, including chapters on hot and cold waves, blizzards, hail-storms, and tornadoes, etc., etc. Illustrated with thirty-two engravings and twenty-four charts. By Gen. A. W. Greely, Chief Signal Officer, United States Army. New York: Dodd, Mead & Co.

February, 1889—Ætat. 47.

247. The King-Devil

History.—Written Sept. 17, to Oct. 17, 1888. As the article is itself a history, nothing further seems necessary.

The Botanical Gazette, Crawfordsville, Indiana, Vol. XIV, No. I, January, 1889, pp. 10-17.

ON the 24th of August, 1879, as I was returning from a hunting excursion of two weeks in the "North Woods" which flank the Adirondack mountains on the west (my own game having been entirely of a vegetable nature), to Evans' Mills, in Jefferson county, New York, where the party was fitted out, we passed through the little town of Carthage, and before having fairly left the town I espied from the wagon an unfamiliar weed growing by the roadside. Leaping from the wagon, as I had done a hundred times before, and plunging my garden trowel under it I brought it up with a clod of earth which I shook off as I ran on and regained the wagon. I immediately recognized it as an *Hieracium*, but quite distinct from any of our native species, with all of which I thought I was familiar. The first glance made me very desirous of obtaining more, but a down grade with good road started the horses on a fast trot and I saw two or three specimens go by before I was able to obtain another without begging the driver to stop for the purpose and seeing him stare impatiently at me, as he, at least internally, cursed me as an incorrigible "crank." At length our speed slackened and I succeeded in obtaining one more specimen in the same manner as before.

I examined the specimens carefully, shaking my head as I placed them in my swollen portfolio, and resolved, that, if possible during my stay in that section, I would obtain more of the plant. Accordingly, on the following day, I gladly accepted the invitation of Mr. Jerry Walrath, since deceased, who was with our party, and a very pleasant gentleman, to take me a long ride

around the country in the vicinity of Evans' Mills, which is chiefly noted as the site of the settlement on Pleasant creek, some three miles above that place, of the early French Le Ray family, the heirs of which preserve the estate almost like a park. I was, I confess, thinking all that day, which I remember with much pleasure, more of my new hawkweed, which I believed to be a modern immigrant from the continent, than I was of the more ancient immigrants about whom my friend so intelligently discoursed. At every fence corner and in every lane I scanned the ground, hoping to see it, until, as Thoreau says, the earnest searcher after a particular plant, the image of which has long been in his mind, will eventually do, I at last espied it, not however, in isolated individuals growing by the barren roadside, but in a large colony, growing compactly together, the radical leaves in prostrate rosettes, forming an almost unbroken mat upon the ground along both sides of a fence that bordered a plowed field. The area was restricted, it is true, to a few rods in length, and to one side of the road, but it looked as if, prior to the last plowing of the field adjoining, it might have extended some distance inward. The plants were smaller and slenderer than the ones I had seen at Carthage, and it was a moment before I became certain of their identity. They represented all stages of advancement, from the buds to the ripening head, and I observed the light akenes, with their feathery pappus, detaching themselves from the plants and being borne away by the wind. I distinctly remember saying to Mr. Walrath, who, as I had told him what I hoped to find and he had seen me get the Carthage specimens, manifested a genuine interest in the matter, that if the farmers of that section did not take measures to prevent it, that plant might become a great pest, a remark which, I doubt not, if he were living, he would also recall. The particular spot where I found the plant on that day was some three miles northeast of the village of Evans' Mills, on the farm of Mr. John Evans, a descendant of the early family who gave their name to that place.

I took a goodly number of specimens and brought them back with me to Washington, where, at the herbarium of the Department of Agriculture, I carefully compared them with all the species of *Hieracium* there represented, and concluded that they agreed better with *H. fallax* Willd. and *H. præaltum* Vill. than with anything else I could find. I sent specimens both of the Carthage and the Evans' Mills collections to Dr. Gray, stating some of the circumstances, and writing on the labels the names of the two species that I thought lay nearest to my plant. I am unable to recall the exact nature of his reply, but I am certain that it was not final and that he desired time to investigate the subject. Getting no further word from him, I distributed most of the specimens under the name "*H. fallax*

Willd.”¹ When Part I of Vol. II. of Gray’s *Synoptical Flora* appeared, my attention was called to the credit given me on page 424 for the discovery of the plant in this country. It is, as he cautiously remarks, “a form” of *H. præaltum*, and I shall presently note the principal points of divergence from the type of that species.

As is the habit of romance writers, I must now ask the reader to figure to himself the lapse of a considerable length of time, viz., eight years. After the smoke of the great battle, which was called the Cleveland meeting of the American Association for the Advancement of Science, was over, I retired, begrimed and discomfited, to the classic banks of the St. Lawrence, where the winds, though sometimes brisk, are not laden with carbon, and where some members of my household had gone before me. The night of my arrival I heard through them that a botanist from Albany had recently visited Evans’ Mills and Carthage in search of a plant that he said I had found there, that he had called on Mr. William Comstock, an intimate friend of mine, and who had been the life of the hunting party above alluded to, and questioned him concerning it. I immediately had my suspicions as to what plant it was, which were fully confirmed a few days later when Mr. Comstock and his wife came from their home in Evans’ Mills and spent a day with us at the Central Park. I learned from them that the gentleman’s name was Peck, and I at once knew that it could be none other than Prof. Charles H. Peck, State Botanist of New York. Mr. Comstock related to me the interview with Mr. Peck as nearly as he could remember it; that he was in search of a plant that I had once collected at Evans’ Mills and Carthage, that the plant was a “hawkweed,” etc. Mr. Comstock said he told him that there was a hawkweed growing there on all the farms which was a terrible pest to the country and had gained the name of Devil-weed, King of Devils, or, more briefly, the King-Devil, but that this could not be the rare plant he was in search of, because it was so extremely abundant, and, besides, it flowered in June, and I had collected my specimens late in August. He further said that, unable to find the plant at that place, Prof. Peck had secured a conveyance to Carthage, and that he understood from the party who drove him there that he also failed to find it there.

The narrative interested me intensely, and I did not hesitate long in accepting the invitation of my friend, Mr. Com-

¹ I wish to say here that, through some curious inadvertence, I now possess neither of the specimens collected at Carthage, and to ask any of my old correspondents to whom I sent the plant (the Harvard Herbarium excepted), who may chance to read these lines to take the trouble to look and see if his specimen is labeled from that place, and let me know if it is, as I would be glad to know where these specimens are.

stock, to come and spend a little time at Evans' Mills, and to go about the country again. To be brief, I spent the most of two days (September 5 and 6, 1888) almost exclusively in the investigation of this question. One hour after arriving there I satisfied myself that the King-Devil was none other than *Hieracium præaltum*, which, as I had predicted, had been sown broadcast by the wind over that entire section of the state, and had now become a veritable terror to the farmers. We traveled over much of the worst infested region and found no one who did not know perfectly well what the King-Devil was. It forms a continuous mat of pale green leaves lying flat on the ground and preventing any other form of vegetation from taking root. In June it sends up a scape, or, more properly, an almost leafless, more or less branching stem, bearing a large number of flowers in a panicle, which quickly ripen and permit the achenia to be scattered by the wind. The stems then die and turn brown, but persist in an erect position, the leaves at the base remaining green, thickening and multiplying and the plants spreading by suckers as well as by seed. This last I proved by securing specimens with two distinct plants attached by the subterranean rhizome.

Notwithstanding this date of normal flowering, I was not disappointed in my attempts to procure good specimens. As the inhabitants well know, the King-Devil sometimes yields two crops of seed. By this is meant that fresh flowering stems will occasionally spring up in late summer, apparently always from plants that did not fruit early in the season. But, as far as my observation went, this was sporadic and comparatively rare. In fields infested with the plant it was difficult to find such autumnal bloomers, but they occur in considerable numbers standing more or less isolated along the roadsides and at other places where there is little or no vegetation. In this condition they could be found at the time I was there, growing very large and thrifty, in all stages from early budding to mature fruiting. My undue zeal led me to collect a very large number of fine specimens, and this is perhaps the place to say that these specimens are for free distribution to any that may desire them.

I made careful inquiries, first, as to the local origin of this noxious weed; secondly, as to the date of its first appearance; and thirdly, as to the exact extent of its present distribution.

To the first of these inquiries I received the almost unanimous answer that it was first seen on the farm of Mr. John Evans, and that from this point it had spread only in an easterly or southerly direction, owing to the prevalence at the time it is in fruit of westerly or northerly winds. As to the second inquiry, while I found those who stated that it had been known near this point of origin for fifteen or twenty years, the consensus of opinion seemed to be that it had not been regarded as a pest for

more than seven or eight years. This last is certainly true, for had there been any such noxious plant in that vicinity in 1879 I should have heard of it, and had it been known then as it is now, I should have been derided for getting off a wagon to dig a specimen of the King-Devil. May it not be that, after a day's search, I found it on that occasion at or near the very nest in which it was first hatched in the United States? I revisited that spot and found it still holding its own, but it had then spread in all directions, and could be found in every lane and by every fence in all that section of Le Ray township.

With regard to its present distribution I could obtain much less satisfactory information. I was told that it had swept a tract of country from five to ten miles wide, but as to the length of this belt no one was able to give any definite idea. Carthage would be immediately in its track, but this is only a distance of fifteen miles. Finally, not having investigated other parts of the state, I am not, of course, prepared to say whether this is really its center of distribution, or whether it may not be equally destructive to other sections, but I incline to believe that such is not the case. It is one of the legitimate questions for the state botanist to investigate, and whenever he shall do so I shall be very glad to learn the result. I am certain that it does not occur among the Thousand Islands or along the St. Lawrence river adjacent, having just spent ten days in studying the botany of that section, with my attention specially drawn to the subject; but the nature of the country here is such that it would scarcely be expected to grow, even if introduced. I met a young man named F. W. Barnes, who resides at Auburn, and who told me that a similar plant, but with purple flowers, was found in that vicinity. At my request, he has sent me a specimen since my return to Washington, which proves to be *H. aurantiacum* L., thus showing the accuracy and clear discrimination of Mr. Barnes, to whom I desire here to express my thanks publicly, as I have already done privately. I have since corresponded further with Mr. Barnes, and he informs me that he knew of this plant only in one place near Auburn, where, as the owner of the land informed him, it had been known for twelve or thirteen years without tending to spread, because it had been prevented from going to seed. He understands that plowing it under kills it. He says that he has never seen the King-Devil in that section of the state, but that he once saw it at Napanee, Ontario, thirty-five miles west of Kingston. If there is no mistake in this last observation, it is a very important fact, and will require us to look still farther westward for the first starting point of our unwelcome immigrant. May it not have been originally a ballast plant of some Canadian port, as Toronto, for example?

Another question to which I gave some attention was that of how this modern intruder can be destroyed or expelled. About

the only remedy that had been tried was that of salting the places infested with it. This, if thoroughly done, kills the plant, but it also kills everything else. It is expensive, and can only be successfully practiced in cases where the plant is still confined to comparatively small spots. If taken in time it can be temporarily kept from a given territory in this way. Its habit is to spread by small colonies, which, if left undisturbed, will eventually become confluent and cover entire fields. A single seed would probably produce one of these colonies in a few years, the original seedling propagating by underground stolons through a succession of generations, and thus working out radially in all directions. I visited the portion of Mr. J. P. Steinhilber's farm, where salting had been practiced some months previous, and saw that it had for the time being destroyed all vegetation, but singularly enough, I found growing in the middle of the area thus blasted several large autumnal specimens of the King-Devil in fine condition for the botanist, two of which I collected and have specially labeled. No other vegetation whatever had sprung up on this sterilized soil. Mr. Wayne Stewart, whom I was unable to meet personally, had conducted the experiment of salting on a large scale, and is said to regard it as a success. After having been destroyed in this way the plant will not reappear until again seeded by the wind from other parts.

The only other remedy I heard of was simply to plow the plants under, when a crop may be raised upon the ground thus plowed, and many of the roots will be killed. The subject should certainly be investigated scientifically at the State Experimental Station and means devised, if possible, to prevent the further spread of so dangerous an enemy of the agricultural industry of the state of New York.

The species *Hieracium praealtum* was originally named by Dominique Villars in F. C. Gochnat's *Tentamen medicobotanicum de plantis Cichoraceis*, 1808. De Candolle, in the *Prodromus*, enumerates five varieties, but he treats *H. fallax* Willd., with its three varieties, as a distinct species. These are now generally regarded as simply varieties of *H. praealtum*, having the leaves somewhat narrower and acute, more or less white-tomentose beneath and the stem sparingly pilose. Some of the varieties occasionally bear stolons above ground, but this is never the case with the New York form, although, as already remarked, subterranean suckers are common. With the exception of the white-tomentose under surface, my specimens would perhaps fall more nearly under the section *fallax*, but in the absence of this character I am disposed to refer them to some of the original varieties of de Candolle, although this is somewhat difficult. The variety *hispidulum* of Froelich is much the nearest, this having the base of the scape and also the leaves pilose-hispid. In our plant there are frequently, but not always, strong and

very long white hairs on both surfaces of the leaves as well as along their margins, but those on the scape are very few and mostly near the base; they are also quite short. The whole plant, except the dark glandular hairy involucre and pedicels, is light green or glaucescent. There are usually two small leaves on the stem, the upper of which, however, subtends the lowest branch, and the other branches are provided with smaller bracts. A minute black ring or speck encircles the base of each hair, and many such occur where the hairs are no longer present.

In the investigation of this plant and the numerous interesting questions arising from its singular advent and diffusion in that section of northern New York, I have been greatly aided by Mr. William Comstock, without whose coöperation I could have accomplished little or nothing, and also by Messrs. Henry L. Lawton and J. P. Steinhilber,² who gave me much practical information, and I desire, in closing, to acknowledge the services of these gentlemen.

National Museum, Washington, D. C.

² Mr. Steinhilber brought me two other plants which he said were becoming quite troublesome. The one was *Potentilla argentea* L., which I had seen abundant in the fields. The other was *Poterium Sanguisorba* L., which I had not seen, but which must have been introduced quite extensively into this country, as I found it in 1883 at Odenton, Md., and it has been found at Baltimore and at several points in New York state. I also have it from Mr. Martindale as a Philadelphia ballast plant.

March, 1889—Ætat. 47.

248. Remarks on an Undescribed Vegetable Organism from the Fort Union Group of Montana

History.—Written Aug. 2-6, 1888. Although this is only an abstract of the communication presented to the Biological Section of the American Association for the Advancement of Science on Aug. 16, 1888, with lantern slides, and without manuscript, still it is all that has ever been published relative to this remarkable plant. Great efforts were made to get the opinion of eminent experts as to its nature. The following persons were consulted and shown either specimens or photographs: Theo. Gill, Richard Rathbun, R. E. C. Stearns, Wm. H. Dall, W. G. Farlow, W. K. Brooks, J. S. Newberry, Leo Lesquereux, A. S. Packard, Alpheus Hyatt, A. G. Nathorst, G. de Saporta, R. Zeiller, H. Sohns-Laubach, Douglas H. Campbell. It was shown to zoölogists because some botanists had expressed doubts as to its being a plant, but the zoölogists unanimously agreed that it was not an animal. The opinion at which I arrived was concurred in by several competent botanists. Prof. Campbell said: "It looks to me more like a combination of *Isoetes* and *Ophioglossum* than anything else." Professor Lesquereux referred me to Dawson's *Carpolithes horridus*, but did not venture an opinion as to its probable affinities. Nathorst thought it belonged to the *Ophioglossaceæ*. Saporta wrote me several long letters, agreeing substantially with the view I had expressed. On Nov. 17, 1888, I discussed the subject before the Biological Society of Washington, reading most of the letters I had received and making full explanations. The only correction that requires to be made is that the beds in which it was found do not

belong to the Fort Union Group, but to the Laramie Group proper.

I did not include this form in my *Synopsis of the Flora of the Laramie Group*, nor in my *Types of the Laramie Flora*, and, as may be seen, no name is given to it in this paper. It is, however, carefully described, and was fully illustrated by the lantern views. I still possess the slides. It should go into the literature of paleobotany with an appropriate name. I certainly never shall have another opportunity to do this, and I am the one who ought to do it. I will therefore here and now (May 3, 1910) give it a name, and when this volume shall appear it will have been duly published according to the rules of nomenclature. Let it then be called *Xantholithus propheticus* n. g. n. sp., the genus name referring to the Yellowstone River, on whose banks all the specimens were collected, some of those from Burns's Ranch actually below the surface of the river and under water, and the specific name to its prophecy of the genera *Isoetes*, *Ophioglossum*, *Lycopodium*, and *Selaginella*, which may have all developed out of this Cretaceous form.

Proceedings of the American Association for the Advancement of Science,
Cleveland Meeting, August, 1888, Vol. XXXVII, Salem Press,
March, 1889, pp. 199-201.

THE specimens were collected in 1883 at two points forty miles apart and on opposite sides of the Yellowstone in the vicinity of Glendive, Montana. At one of the localities, viz., Iron Bluff, twelve miles above that town and on the right bank of the river some fifteen meters above low water mark, it occurs in a red burned cliff in light arenaceous clay, the specimens being very large, sometimes measuring thirty centimeters across. At the other locality, namely Burns' Ranch, twenty-eight miles below Glendive on the left bank of the river and close to the water's edge, the specimens are smaller and more perfect, being embedded in a fine grained bluish clay shale. The fossil shows a large circular center 2-7cm. in diameter from which there proceed in radial arrangement in all directions a large number of single flexible stems varying in length and having a width of 2-3 mm. These horizontal, radiating stems are sometimes slightly sinuous, lying upon and often crossing one another. They exhibit for most of their length, beginning near their attachment to the center, a row of toothlike appendages on each side, which are about $\frac{1}{2}$ mm. in width at the base and about 1mm. apart, obliquely ovate in shape with obtuse tips and always projecting forward

toward the distal end of the stem at an angle of 50° . Close examination with a high power reveals the presence of a continuous epidermal membrane composed of hexagonal cells connecting these projections. The stems are uniform in width and not marked by any longitudinal costa until within some 3cm. of the apex when they expand into an elongated elliptic blade, or head, terminating the stem. Through the center of each of these heads run two rows of what appear to be spore-cases, one on each side of the median line and separated from each other by a very narrow interval forming a continuous groove running longitudinally through the head. The supposed spore-cases are somewhat elongated transversely, and arranged in pairs, filling most of the surface of the head, but leaving a winged expansion at the central or widest portion. They average $1\frac{1}{2}$ mm. in length and $\frac{1}{2}$ mm. in thickness. Below the base of the head, where the teeth begin, they appear to cease, but in most cases a careful inspection reveals their presence in an obsolete and probably functionless form, and this is sometimes distinguishable for considerable distance down the stem where it assumes more the aspect of a series of articulations widening as the center is approached. The lateral teeth of the stems usually cease below the head, but cases occur in which they continue for some distance along the margins of the expanded lamina.

Considerable, but not as yet exhaustive, search has been made through the literature of paleontology to find the analogues and determine the affinities of this singular organism, as yet almost entirely without success, the forms figured under the names *Discophorites*, *Gyrophyllites* and *Tænidium*, perhaps having the greatest resemblance, but not close enough to indicate any relationship. Specimens have been shown and sent to a number of eminent paleobotanists and paleontologists, but none, so far as heard from, can give any idea of its nature. Its vegetable character having been questioned it has also been shown or sent to the best authorities on invertebrate zoology in this country and in Europe. Those who have thus far expressed an opinion have uniformly denied its relation to any known animal. It is remarkable that it is the botanists who have suggested its possible animal nature, the zoologists inclining to regard it as a plant.

Having collected and long studied the specimens, superintended their delineation, and compared them, with a great number of forms both fossil and living, I may be permitted to advance in a few words as possible, the theory which I provisionally hold as to the nature of this organism, as follows: I am disposed to regard it as a "comprehensive type" of vascular cryptogamic life, embodying some of the characters of several well known living types, viz., 1. The large tufted central base is suggestive of that of most species of *Isoetes*, and the long weak stems of certain of

these species are observed to recline and lie prostrate in all directions around this center. 2. The double row of spore-cases at the apex of the stem agrees in all essential respects with that of *Ophioglossum*, and the elliptic expansion may be regarded as homologues of the larger blade-like fronds of that genus, which may easily be imagined to have the spores borne along its median line instead of on a special fruiting frond. 3. The prostrate sinuous habit is not widely unlike that of certain creeping species of *Lycopodium*, as, *e. g.*, *L. annotinum*, and the tooth like appendages may be the reduced homologues of the scale-like leaves of that genus. 4. A still further approach is seen in *Selaginella* where the scales have become distichous and the stems flat and closely creeping. This parallel is well-nigh complete in those species, such as *S. Douglasii*, in which the spores are borne in terminal spikes, like those of most *Lycopodiums*, except that these are more or less flattened and two-ranked. 5. Finally, ignoring the appendicular organs of *Marsilea* we see in the fruit-bearing portion a further analogy to our fossil, the fruiting stems radiating from the thickened base and bearing the spores at their apex.¹

The fossil would thus represent a highly generalized type and may be phylogenetically related to all these more specialized modern forms with each of which it seems to possess some characters in common.

The paper was illustrated by lantern views of the original fossils and of carefully prepared drawings.

March, 1889—Ætat. 47.

249. The Paelontologic History of the Genus *Platanus*.—Abstract

History.—Written Aug. 7, 1888. Read Aug. 16, 1888 (see supra, p. 140).

Ibid., pp. 201–202.

¹ Since the date at which this paper was read communications have been received from the Marquis Saporta and from Dr. A. G. Nathorst, both of whom agree that the organism is probably a cryptogamic plant related to *Ophioglossum*.

April, 1889—Ætat. 47.

250. Some Social and Economic Paradoxes

History.—Written Jan. 22, to March 20, 1888. Read before the Anthropological Society of Washington March 20, 1888. A final draft was made December 11–24, of the same year and on the 29, I read it before the American Economic Association at its meeting in Philadelphia. This was a great triumph for me, as I was a new member and it was my first appearance before economists. The following, copied from my notebook written the same day, may be discounted by the reader according to his mental attitude:

"The hall was full and everything most propitious. I did my 'level best' and was perfectly composed. In fact my wits were somewhat stimulated, and I put in several excellent things not in the manuscript. One could have heard a pin drop, so perfect was the attention. I repeated every one of the leading theorems or paradoxes, so as to be sure to be perfectly understood. The applause at the conclusion was vociferous, and I received many warm congratulations. I have many reasons for believing that it was a complete surprise to most of them."

The editor of the *American Anthropologist* asked me for the paper about the middle of January, 1889, and I let him have it. It appeared sometime in April.

I sent this article to Mr. Henry C. Long and he published it entire in the *Cleveland Citizen*, running through four numbers.

The stimulus to the writing of this article came from the reading of Mr. George Gunton's *Wealth and Progress*, in November and December, 1887. Later I followed up the subject of paradoxes and greatly extended the list, which appeared in its final form in my *Psychic Factors of Civilization*, pp. 278–279.

The *American Anthropologist*, Washington, D. C., Vol. II, No. 2, April, 1889, pp. 119–132. Compare *Science*, New York, Vol. XI, No. 271, April

13, 1888, pp. 172, 174-176; *The Cleveland Citizen*, Cleveland, Ohio, Vol. I, No. 29, August 15, 1891, p. 1; No. 30, Aug. 22, 1891, p. 1; No. 31, Aug. 29, 1891, p. 1; No. 32, Sept. 1891, p. 1.

DR. RICHARD T. ELY, professor of political economy at the Johns Hopkins University, once did me the honor to preface one of his lectures by quoting from my work on "Dynamic Sociology" a passage relating to what I called the "paradoxes of nature," and by saying that the principle there involved was one that could be profitably applied to economic studies in general. I have since felt that perhaps it would be well, before others had gone far in this direction, for me to indicate some of the ways in which I had already foreseen the practicability of such an application, not only because it seemed fitting that I should break the way, but also because I somewhat apprehended that the principle might be inadequately grasped and erroneously applied. I carried it through the entire range of physical phenomena, showed its application to the world of life and of mind, pointed instances in morals, and introduced it into the domain of sociology. Even with my scanty reading in political economy, I was able to see that it was specially applicable to that field, but I did not feel qualified, nor do I now, to advance with confidence in this direction.

Without repeating anything that was there stated, I may mention as typical cases the rotundity of the earth and its revolution on an axis, both of which are facts directly opposed to common observation and unknown till the age of Copernicus. A closer examination shows that these cases are not exceptional, but that all natural truth contradicts the untrained experience of man, so that the apparent is always opposed to the real.

Until a domain of forces has become the subject of scientific study and discovery the phenomena it presents are in the highest degree illusive, and therefore the less a science is understood the less confidence can be placed in the theories which its phenomena appear to establish. Social and economic science deals with human motives and desires as its forces and human activities as its phenomena, than which nothing is more complex and difficult, and in such a field we should naturally expect that the greater part of what appears to be true is merely apparent, and that most of the real truths should seem to the common observer to be false. In the physical world science has now so far advanced that each new proposition has come to bear a certain mark, which, to the truly wise, distinguishes the genuine from the spurious or, at least, the legitimate from the illegitimate. Time was when this was not the case, and we are now, I believe, in a phase of the progress of social and economic science in which

no such distinction is apparent among the theories that are current. Each one has to be separately scrutinized, an original judgment must be passed upon it, and it must be accepted or rejected wholly upon its own inherent merits.

I propose in this paper to point out a few of the maxims of social science, and especially of political economy, which appear to be on trial and to indicate what, as it seems to me, will probably be the verdict of time as to their acceptance or rejection. But in this I do not arrogate to myself any gift of prophecy or infallibility, for most of these problems are knotty and obscure, and it is of the utmost importance to recognize how much of what seems to be true is false and how much of what seems to be false is merely paradoxical.

I shall speak chiefly of certain statements of a few modern economic writers which are so much at variance with the current doctrines of political economy that, if true, they are certainly paradoxical, but before coming to these, and as a sort of preparation for them, I will first mention a few other propositions of a much broader character, which, assuming their correctness, may properly be called social or sociologic paradoxes.

I have preferred to state these apparently false propositions for the sake of defending them rather than to state the opposite and apparently true ones for the sake of combating them, because it is less important to lay stress upon the error contained in the latter than upon the truth contained in the former, and also because the method of explaining paradoxes possesses a certain novelty which that of exposing fallacies does not, and this of itself may add some zest to a subject which at its best, will be regarded as dry, even if it be less "dismal" than the old-time political economy.

Perhaps the broadest of the paradoxes which can be claimed as sociologic, and which certainly applies to the next lower stage of biologic law, and still more obviously to physical phenomena, is embodied in the theorem that

The artificial is superior to the natural.

Certainly this proposition does not seem true, but, on the contrary, seems to contravene all our common instincts and intuitions; but when subjected to the proper tests it is found to be true in all the simpler departments of knowledge. Man can make very little use of anything in its natural state. Value, *i. e.*, utility, is imparted to raw materials only by labor and skill. The products of labor and skill are artificial, and scarcely anything has *actual* value, *i. e.*, capability of actual, immediate use, until it has been transformed from the natural into the artificial state. Therefore, if that which can be used is superior to that which cannot, the artificial is superior to the natural. Even those vegetable and animal products which have most value—the cereals, fruits, vegetables, superior breeds of cattle, horses, sheep, fowls, etc.—

are the products of thought, intelligence, careful selection, and prolonged artificial culture and care, showing that the proposition holds true in the complex department of life as well as in the domain of mechanical law. It should and does hold true in the social world; but here, and here only, some of the highest authorities have disputed it. They decry all attempts at the artificial production of a higher social product, and call this interfering with natural laws. They base their opposition upon the idea, either expressed or implied, that the natural is superior to the artificial. This from our present standpoint is a *petitio principii*. It has usually been regarded as conclusive because no one seems to have questioned the major premise. This itself is now seen to be false when applied to the better-known departments of natural law. To deny of social forces what is admitted of physical and vital forces is to deny the existence of a social science. But our proposition does apply to society, for if it were true that the natural is here superior to the artificial then would anarchy be preferable to government.

Limiting the subject to this department, the strictly sociological paradox may be put in this form:

Social activities may be artificially regulated to the advantage of society.

Political economists maintain that the normal action of the laws that govern the social and industrial world are not only economical, but the best possible, and cannot be disturbed with impunity. The philosophers of the individualist school take the same view. They sometimes go so far as to deny the expediency of sanitary regulation in cities, and maintain that the disease and mortality due to bad drainage will secure the improvement of the drainage by stimulating individual effort. They would have the lighting and paving of streets accomplished in the same way. Thus Mr. Herbert Spencer, who is admitted by all to be the leading sociologist of the world, says that

"either by general government or by local government the levying of compulsory rates for draining and for paving and lighting is inadmissible as indirectly making legislative protection more costly than necessary, or, in other words, turning it into aggression. * * * Respecting sewerage there would be no difficulty. Houses might rightly be drained on the same mercantile principle that they are now supplied with water. It is highly probable that, in the hands of a private company, the resulting manure would not only pay the cost of collection, but would also yield a considerable profit. But if not, the return on the invested capital would be made up of changes to those whose houses were drained, the alternative of having the connection with the main sewer stopped being as good a security for payment as the analogous one possessed by gas and water companies. Paving and lighting would properly fall to the management of house-owners. Were there no public provision for such conveniences house-owners would quickly find it to their interest to furnish them. Some speculative building society having set the example of improvement in this direction, competition would do the rest. Dwellings

without public footways before them and with no lamps to show the tenants to their doors would stand empty when better accommodation was offered; and good paving and lighting having thus become essential, landlords would combine for the more economical supply of them."

This is merely an example of the absurd lengths to which this favorite theory leads such writers. In the light of the sanitary progress of the nineteenth century, due entirely to organized social effort, such statements scarcely seem to emanate from a sane mind.

Starting from such extremes, it would not be difficult to show that the general doctrine of *laissez faire* is unsound when contemplated as a universal principle of sociology, and so much has latterly been said upon this point that many good writers, even in England, who still desire to hold on to the doctrine, such as Cairnes, Sidgwick, and Lefevre, are giving up its universal applicability and only contending for it in many cases on the ground of expediency. No one asks more than this, as no fair-minded person will deny that it is often better to allow the most absolute free play to the natural agencies, not merely of society, but of physical nature as well.

Not to dwell longer upon such broad generalizations, and coming now nearer to the domain of economics, I will state, at the risk of some apparent abruptness, another paradox in the following words:

Reforms are chiefly advocated by those who have no personal interest in them.

I do not claim that this is universal, and there usually comes a time in the history of every reform when the victims of the evil to be reformed join in the work and help to secure its consummation. But in some cases, such as the abolition of slavery, even this does not take place. Associations that are organized for charitable, benevolent, and reformatory objects are composed almost exclusively of persons who are actuated by purely altruistic motives and have nothing to gain beyond the approbation of their fellows. Labor-reform movements are usually instigated and largely prosecuted by persons who are only interested in their success from some high moral point of view. Sometimes they are the employers of labor, and workingmen's parties are often officered by lawyers, clergymen, professors in colleges, or writers on social topics. Selfish designs and personal ambition they doubtless often have, but very rarely are they men who would be pecuniarily affected by the success or failure of the cause.

I have introduced this principle chiefly in order to lay more special stress upon an important corollary to it, viz., that

Discontent increases with the improvement of the social condition.

No one will deny to this proposition, provided it can be proved true, the character of a social paradox. The mind naturally

reasons that as the causes for complaint are removed the discontent should diminish. But such has not been the history of past progress; it is not the condition of the present progress of society. The reason for this, like the reasons for all natural truths, which seem false when first stated, is clear when the explanation is furnished. We saw that in the case of emancipation the entire reform must be accomplished by others than the victims of slavery. We even hear of slaves who do not want their freedom. But however much they may want it, they are powerless to obtain it. And it is largely so with the industrial classes, who are not slaves in the accepted sense of the word. But up to a certain point they are, as truly as real slaves, both incapable of realizing the need of reform and powerless to act in improving their condition. Discontent is proportioned to the degree in which an oppressed class realizes its condition, and increases with the knowledge that relief is attainable by action. But this stage is not reached until external influences have already wrought an important change for the better. The French revolution did not come until the comparatively liberal king, Louis XVI, had called Turgot, a friend of the third estate, to his court and a great mitigation of popular grievances had taken place. Women did not begin to demand legal rights till most of the discriminations of the common law against them had been removed by statute. And, as we shall see, the workingmen did not become an element in politics until a great amelioration had taken place in their general condition.

This is the meaning of the paradox that discontent increases with improvement, but it should be noted that this presupposes the existence of hardship, and would be no longer true if entire justice could be attained.

The special importance of this law arises from the fact that one of the leading arguments against all attempts at industrial reform has been that the condition of the laboring classes is really improving. Mr. Henry George has greatly injured his case by denying this. His "Progress and Poverty" is little else than an elaboration of this denial—a systematic attempt to establish an untruth. This book has proved useful in stimulating honest inquiry into this question. It is now admitted at all hands that the condition of the working classes has improved and greatly improved in nearly all civilized countries. And it is claimed that on this account the discontent of labor is without good reason. But those who take this view do not understand that this discontent is wholly on account of the improvement that has taken place in the workingman's condition. It does prove, however, that the reform is not yet complete, and a movement that has reached the stage of arousing wide-spread discontent can never be arrested until all just grounds of discontent have been removed.

The next paradox to be considered is that in industrial society

The means of subsistence increase more rapidly than population.

This, as will be observed, is exactly reversing the Malthusian doctrine. The almost universal acceptance of that doctrine, especially by political economists, is sufficient to give to this proposition the paradoxical character claimed for it, provided it can be shown to be true. This proposition Mr. Henry George, in the work already referred to, undertook to defend, and in this, I must admit, he was successful. In doing so he seems to have grasped the important truth that society is to be regarded as a great coöperative institution, which naturally economizes the forces of production. Those who understand what the value of co-operation consists in know that the more general it is the more effective. Society, though a very imperfect form of coöperation, is a very general one, and it results, defective as it is, in a greater production *per capita* than could be secured by each individual working for himself—that is to say, the denser the population the greater the amount of subsistence produced by each person.

Two curious results flow from this, both of which are decidedly paradoxical: One is that this is the very truth which has been so exultantly brought out by the chief defenders of Malthusianism when showing that the condition of the disaffected classes is improving. It is improving and has been improving, with a few temporary interruptions, ever since the beginning of the industrial epoch; but this improvement has been the result of the division of labor, the employment of machinery, and of the general social integration and coöperation which the increase and massing of population call forth. The denser the population the greater the friction of mind upon mind, the more rapid the development of intelligence, the quicker the action of the inventive faculty, and the more exact, methodical, and economical the outlay of energy in the production of wealth. Everybody is familiar with this law in the obvious contrast between the intelligence and thrift of city and of country populations, and no part of the earth has ever been so densely peopled that it could not produce wealth more rapidly in proportion to population than when less densely peopled, provided there were no physical obstacles, such as enforced isolation, governmental oppression, or protracted war. The only other exception is in the case of rude, barbaric, or effete races, whom nothing can stimulate, and who possess no proper arts or industries. It is singular that the law of Malthus should be applicable only to these last-named cases—to savages and barbarians—and only partially to these, since association sharpens even their faculties. As a matter of fact, the Malthusian theory ignores the existence of mind and finds its only perfect expression in the animal world, where Darwin took it up and applied it to the

immense advantage of biologic science. With the advanced human races the truth is found by exactly reversing the maxim of Malthus.

The second curious result of the truth, so successfully established by Mr. George, is that it serves as a flat contradiction of the fundamental theorem of his own book, viz., that poverty increases with wealth. It would, of course, be easy to find isolated cases, perhaps important departments of industry, in which the haphazard development of modern wealth-producing agencies has worked severe temporary hardship, but that they tend, using the old phrase, "to make the rich richer and the poor poorer" in any permanent or systematic way may be regarded as completely disproved.

Coming now fairly within the field of political economy, as that science is usually defined, let us note a paradox, which may be more or less directly affiliated upon the one last considered. It may be stated in this form:

Capital does more than labor towards the production of wealth.

In view of the popular belief that labor creates all wealth, this, if true, must certainly rank as a paradox. To perceive its truth we must consider what constitutes capital, and to do this successfully we must, for the time being, cut loose entirely from all the current definitions, however true they may be, and look at the problem from one special point of view. It is a common thing to hear it said that in the modern industrial world it is not human power that produces most of the wealth, but natural forces. This is true, and is one way of looking at it. It is equally common to hear it said that it is not muscle, but brain, that accomplishes the chief results. This is also true, and is another way of viewing the question. Brain—i. e., intelligence—organizes and directs natural forces and the latter do the work. Still a third point of view is taken when it is said that it is machinery that performs most of the service. Machinery is the material embodiment of this intelligent direction of natural forces. But there is a fourth possible way of contemplating this superhuman production of wealth, if I may be allowed such an expression, which few, I imagine, have employed, and that is to ascribe it to capital. Yet it is clearly correct to do this. The other explanations I have given are all partial and incomplete. The term "machinery" is too narrow. Even when it comprehends all kinds of implements and utensils it still fails to cover all forms of productive industry. "Natural forces" is an expression which requires the subtle explanation that it includes the properties of material substances to render it complete. "Intelligence" or "brain" is still more vague and difficult to reduce to economic language. But "capital" includes all these and every other possible agency

or factor, and it is really to this that all production beyond what could have resulted from the exercise of naked human muscle is due. I need not attempt to explain how small a part of human wealth this latter would be. But this view of the subject brings out with especial force the truth of the original proposition with which we set out, that the artificial is superior to the natural.

Passing over the proposition that

Wages are drawn from products, not from capital,

which would have sounded paradoxical a short time ago, but is now accepted by most advanced economists, I now come to what I regard as the most important, as it is perhaps the most debatable, of all economic paradoxes. It may be expressed in the following form:

Profits rise with wages,

or in the stronger form:

Increase of wages results in increased profits.

Surely this proposition would stagger an old-time political economist, and very few employers, with the aid of the alleged unerring mercantile sagacity, could be brought to accept it. In fact, not only is the exact opposite theory the only one taught in the books, but the business of the whole world has always been conducted upon it, and to the normal mind the statement that profits will diminish as wages increase seems to be self-evident. How, then, can the opposite be maintained?

We owe to Mr. George Gunton, the author of a recent work entitled "Wealth and Progress," the full elaboration of this new theorem, and to that work I must refer any who care to go more deeply into the question. The manner of proof is something like the arguments advanced in favor of non-resistance. Any one who understands it must admit its soundness, and yet if any small number were to attempt to practice it they would surely fail. It may be briefly stated somewhat in the following form:

Political economy, as expounded in all the books, teaches that industrial society is divided into two great classes—producers and consumers. In this classification the wage-receivers are uniformly regarded as producers. The consumers are a class who go into the market and purchase the products wrought by the wage-receivers. They are vaguely conceived, illy defined, never distinctly located, and, except that they do actually buy the goods and consume them, they are a sort of economic myth. The question, then, naturally arises, Who are these consumers? where are they? what are they? And when fairly looked at the answer is not difficult. A consumer is a human being. He is part of the population.

Somewhere in the population he is to be found. But who is there that is not a consumer? Clearly, no one. The consumers are the whole population. The wage-receivers must, therefore, be both producers and consumers, and when we consult the census we find that they, with their dependents, constitute the great majority. Therefore, in all calculations based upon the nature of the market, not only must they not be ignored, but they must be regarded as the prime factor. It may be said that they consume much less proportionally than other classes. Their humble rank and simple wants make them scanty consumers, and therefore it is necessary to bid for the custom of the middle and upper classes and ignore the laboring classes. No one will claim that they consume as much *per capita* as the rich, and of many products they consume none. But here again we may properly ask, why is this so? The obvious answer is, because they have not the means. But will any one claim that the working classes consume all they would if they had the means? Surely not. There may be some so low that they could make no use of anything more than they have, but this is scarcely conceivable. With hardly an exception they want much which they cannot have because they have not the means to purchase it. But their means consist wholly in their wages. To increase their wages is to supply their wants. The laborer wants increased wages only that he may supply his needs, *i. e.*, that he may become a larger consumer. The employer is apt to look at the question as though all that were paid for labor beyond the absolute minimum would be hoarded and lost to industry. This view, tacitly shared by the economist, is obviously false. What to the laborer is the supplying of his wants is to the manufacturer and the farmer expanding the market. The vast number of laborers and the certainty that all increase of wages will be expended and not hoarded make even the smallest general rise in wages an important stimulus to production. It enlarges the market for all classes of products. Statistics show that periods of high wages have uniformly been periods of increased production, and increased production means prosperity to the manufacturer—*i. e.*, profits rise as wages rise.

From this, as the fundamental law, a large number of new and striking results, most of them in the nature of paradoxes, arise. Only a few of these can be considered here. One of them is that

Prices fall as wages rise.

This is maintained by Mr. Gunton in the face of his general law that the price is determined by the cost of production. Surely, one would suppose that the cost of production would be greater if the cost of labor were increased. Just here lies the paradox. Doubtless this would be true for an isolated case, but it would not be true where the rise in wages was on a large scale. The reason

is that with the increase in wages the market is enlarged and production must be correspondingly increased. But as production was at the maximum for existing methods before, the increased production must now be brought about by an improvement in the methods—*i. e.*, by the introduction of improved machinery. This always lessens the cost of production, and as prices depend upon the cost of production they will necessarily fall.

To this law rent appears to be an exception, and there is reason to believe that Mr. Gunton so regards it. One would naturally suppose that rent, as the price paid for lodgings, business offices, space to build or work upon, or land to cultivate, would follow the law of prices and fall as wages rose. Mr. George virtually asserted this in maintaining that the rent was taken out of wages, so that the higher the rent the lower the wages. But Mr. Gunton shows that as rents have risen wages have also risen; that the highest wages are paid where the highest rents are charged, *viz.*, in cities, and that the lowest of all wages are received by those who pay no rent at all, but occupy the soil without let or hindrance. Nevertheless, I cannot admit that all this makes rent an exception to the law of prices. For although as wages rise higher rents will be paid, still they are paid for better tenements or more advantageous sites. The occupation of better premises is equivalent to increasing consumption, and this is the result of increased wages. Not only will better food, clothes, and furniture be obtained, but also better houses, shops, offices, and locations.

But perhaps the most important of the conclusions to which such an inquiry leads are those relating to the hours of labor. Two of these may be briefly considered. The first is that

A reduction of hours tends to increase production.

This perhaps sounds more paradoxical than any of the foregoing propositions. It seems absurd to say that more will be produced in eight hours than in ten. But let us see: The laborer remains a consumer the same after as before the reduction. Unless more machinery be introduced the same amount of manual labor will be required after as before to supply an unchanged demand. Hence a larger number of laborers must be employed. These, in the present state of industry, are always to be had. The average number of able-bodied workmen constantly out of and seeking employment is estimated to be one-fifth of the whole. As many of these as it required to balance the decrease of hours would at once find employment. While unemployed the amount consumed by them is at an absolute minimum. As soon as they begin to receive wages they begin to consume more, and thus the demand for various commodities is increased. This demand is sure to be met by increased production, which will be secured

by the introduction of improved machinery if it cannot be done otherwise.

But this is not the only way in which a reduction of the hours of labor works an increase of production. By affording a little leisure to the workingman it gives him a taste, or rather an opportunity to indulge a taste already possessed, for certain elements of culture and certain social refinements which he will then begin to demand and which will be accordingly supplied, still further increasing the quantity and varying the quality of production.

But assuming that the workingman's earnings were previously all expended on necessities, this last consequence would be impossible, and hence arises the final paradox, that

The reduction of hours tends to increase wages.

But for the foregoing explanations this would sound strangely enough. Whenever there is an appeal for a reduction of hours it is always met by the reply that in the state of business it can only be granted on condition that wages be correspondingly reduced. Business competition is supposed to render profits impossible under any such change, and this doubtless would be the case with isolated industries, at least at the outset. A reduction of hours is considered equivalent to an increase of pay. But even on this view we have seen that, in the long run, profits rise with wages, and they may, therefore, be expected to rise with a reduction of hours. If the reduction is made general and continued long enough to produce its natural and final effect upon industry and upon society, it will certainly create an increased demand for all classes of commodities, requiring the introduction of improved machinery and methods in their production, cheapening the cost of their production, and thus so far increasing the profits of the manufacturer as to enable him to pay higher wages. In fact, he will be left no choice of his own in the matter, but under the laws of business competition he will be compelled to do so to prevent a reduction in his profits.

Without dwelling longer upon these several propositions I will close this paper with a single comment. If any considerable part of what is claimed is true it proves in a most conclusive manner what I have so often insisted upon, that to the power of production there is practically no limit, and that all that is needed to place in the possession of every member of society every object of his desire is the power to purchase it. Very few indeed are there who possess or can possess every purchasable object of desire. The present production of industrial society would not be equal to a tenth, probably not to a hundredth, of what would be consumed if every one could supply at will every proper and legitimate want of his nature. It is, therefore, useless to talk of

increasing production except by the increase of the power to consume. The problem is, therefore, no longer how to increase production, but how to increase consumption—not the desire to consume, for that already exists, nor the ability to render an equivalent, which is also abundantly possessed, but the chance to exercise that ability in the gratification of that desire; in a word, *the opportunity to earn*. That the reduction of the hours of labor is one of the means to that end is certainly clear. The discovery of other means and of the best way to put every means into practice seems to me to constitute the chief economic problem of our times.

June, 1889—Ætat. 47.

251. Seventh Annual Report of the Geological Survey, 1885-86, Washington, D. C., 1888, pp. 123-126.

History.—Written July 1-3, 1886.

Seventh Annual Report of the U. S. Geological Survey, 1885-'86, Washington, D. C., 1888, pp. 123-126.

June 15, 1889—Ætat. 47.

252. Carboniferous Glaciation.*

History.—Written June 9, 1889.

Public Opinion, Washington and New York, Vol. VII, No. 10, June 15, 1889, p. 221.

THE importance attached by geologists to the subject discussed in this pamphlet, and the able and compact manner in which a large and widely scattered literature is here brought together and placed within reach of the ordinary reader, seem to justify, and even to demand, some mention of it. Every well-informed person is familiar with the idea of a glacial

* *Carboniferous Glaciation in the Southern and Eastern Hemispheres With Some Notes on the Glossopteris-flora.* By C. D. White. Reprint from the *American Geologist* for May, 1889, p. 299.

epoch, or several of them, occurring just before, or, as many believe, since the appearance of man on the earth, and most educated people understand that geologically speaking this was a very recent event—an event, as it were, of yesterday—compared with the vastly ancient period when the great coal beds of the world were locked up in the earth. It is also generally believed, we may almost say known, that the temperature which prevailed at that ancient time was much warmer than now, and that the coal plants lived in a tropical and very moist climate, in which the waters perpetually gave forth clouds of mist and vapor through which the sun may have never been able to penetrate. But the fact that is now being brought to light, and with which this paper deals, is that far back in that remote age of the world, contrary to what has heretofore always been supposed, a change took place in the climate of the southern hemisphere as shown by indications which the geologist can not mistake in India, Australia, and Africa, and perhaps also in South America, and that there then occurred on that side of the equator at least a true glacial epoch, analogous to those so well understood to have occurred in more recent geologic time. The other fact, which, of course, flows naturally from the first, but which has a special import for the modern geologist, is that along with this change of climate there went a complete change in the character of the vegetation, and this has always been a great enigma until thus explained. In the strata which all other indications declared to be carboniferous were found plant remains agreeing with those of a much later age in Europe and North America. Mr. White pointedly suggests that as the period of glaciation gradually ceased and the warm climate returned this new flora migrated northward, and reappeared at a later epoch in the Mesozoic of Europe and of the United States. In this way one of the worst stumbling blocks of modern geology is satisfactorily removed and a long and somewhat acrimonious controversy is ended. The paper is scholarly and philosophical, the style suggestive rather than full, and the reader is left with the distinct impression that there is a reserve fund in the author's well-stored mind from which a dozen such articles, if not a volume, might, and probably sooner or later will, be drawn.

July 25, 1889—Ætat. 48.

253. Fortuitous Variation

History.—This note was written Dec. 25, 1888, and is all that was ever published of my paper, which consisted entirely in the exhibition of, and comments on, a series of specimens of the genus *Eupatorium* which I had collected myself, including all the species that grow in the vicinity of Washington, and all that I had ever met with in other parts of the country. These specimens were nicely mounted on white sheets from my herbarium and appropriately labeled. The genus had always interested me on account of its clean-cut, definite character, with very little tendency for the species to run into each other.

That Darwin taught the doctrine of fortuitous variation there can be no doubt. The only question is whether he ever used that phrase. I had always been under the impression that he had used it, and did not think at the time of reading this paper of claiming even the phrase as my own. But I have not been able thus far to find the phrase in Darwin's works, though he speaks of "spontaneous" variations. It is just possible that I may have been the first to call them fortuitous. The principal reason why I sent the abstract to *Nature* was because I regarded it as a Darwinian doctrine and I wished to emphasize it before British naturalists.

On August 31, 1889, I received the following communication:

"GEANIES, FEARN,

"ROSSSHIRE, SCOTLAND, Aug. 17, 1889.

"DEAR SIR:

"I have read with much interest an abstract of your paper on Fortuitous Variation in *Nature* July 25. Might I ask you kindly to send me the paper itself?

"G. J. ROMANES.

"Is it possible to procure drawings of the different kinds of leaves which you mention?"

Of course I was obliged to tell him the circumstances under which the paper was read. After his return from the meeting of the British Association he wrote me a long letter (dated Oct. 8) in which he described his defence of this doctrine against Wallace's idea of the necessary utility of all variations, and said that he alluded to my note. He claimed to have been using the phrase "fortuitous variation," but did not refer me to any definite passage. I have not tried to find it in his writings.

Mr. Charles F. Clark of the Department of Experimental Plant-Breeding of the Cornell University College of Agriculture wrote me under date of Dec. 23, 1908, saying that he understood that I was the first to use the term "fortuitous variation," and asking me to refer him to papers in which I had used it. Since this note appeared I have used it a number of times, and latterly I have shown its connection with mutation, its value in explaining the non-advantageous intellectual faculties of man, and its numerous sociological applications.* I possess the rough draft of the note and am using it here as copy for this work.

Nature. A Weekly Illustrated Journal of Science, London, Vol. XL, No. 1030, July 25, 1889, p. 310.

AT a meeting of the Biological Society of Washington held Dec. 15, 1888, Mr. Lester F. Ward read a paper on *Fortuitous Variation as illustrated by the Genus Eupatorium*.

He exhibited a series of specimens of that genus mostly from the vicinity of Washington, and growing in great part in the same kind of soil and under the same general conditions. To simplify the question the differences in the flowers, heads, and reproductive parts in general, which are less marked in this than in almost any other genus, were ignored, and attention was exclusively directed to the leaves. These when closely compared are seen to differ considerably in the different species, the forms ranging from the filiform dissected leaves of *E. fœniculaceum* to the broad ovate leaves of *E. ageratoides*. But between these extremes there are represented in the Washington flora numerous much more similar forms, which present to the observer a strongly marked family resemblance, from those with more elongate leaves, such as *E. altissimum*, *E. album*, and *E. teucrifolium*, through the increasingly broader

* See *Pure Sociology*, pp. 240-242, 253, 480, 500, 501.

more ovate forms *E. perfoliatum*, *E. sessilifolium*, and *E. rotundifolium ovatum* (*E. pubescens* Muhl.), with an intermediate undescribed form, which Dr. Gray regarded as a hybrid, connecting the last two, to the typical *E. rotundifolium*, with its roundish, crenate, but still sessile leaves; and from this last form, with several similar Mexican species, on in the direction of acquiring a petiole, through several exotic forms, to *E. cælestinum*, *E. aromaticum*, and *E. ageratoides*, in an almost unbroken chain of modifications without any apparent advantage to the plants. Almost any other genus would have served the purpose of the paper, but this one seemed to possess the merit of simplicity.

The question naturally arises in looking at such a group of clearly related forms, all of which on the modern view must surely have descended from some common ancestral stock: Why have they varied at all? Why need there be more than one species of *Eupatorium* in the same restricted flora? Or, if some can be shown to have probably varied in order to adapt themselves to different conditions, Why need there be more than one form occurring under precisely the same conditions? Variation caused by natural selection can only occur where some advantage is secured through it, whereby the new form becomes, by ever so little, better fitted to survive under the conditions of its existence. But here there seems to be no such advantage. It is easy to say that we are incapable of detecting the subtle influences that make one form surer of existence than another. The staunch believer in natural selection may be satisfied with such an explanation, but is it not too much to ask of the new convert or the skeptic? Is not the spread of the doctrine hindered rather than helped by such a demand? Moreover, it was shown that several different forms actually flourish together in the very same localities, and that this is not exceptional but the common case, so that the idea of special fitness of form to station is precluded. And is it not antecedently improbable that there should be any advantage in a plant's having a sharp-pointed rather than a blunt-pointed leaf, a serrate rather than a crenate one, a sessile rather than a short petioled one? Science becomes metaphysics when such questions are discussed.

The speaker proposed to escape the dilemma by denying that advantage, or fitness to survive, or natural selection, had anything to do with such variations; and he maintained that they were purely fortuitous in the only true sense of that term. By this he did not mean to say that they were due to mere chance in the sense of being without cause; and the remainder of his paper was devoted to an attempt to explain the cause of fortuitous variation. It may be briefly summed up as follows:

Organized, or living, matter constantly tends to increase its quantity, which may be regarded as the true end of organic being, to which the perfection of structure, commonly mistaken

for such end, is only one of the means. Every organic element may be contemplated as occupying the center of a sphere, toward the periphery of which, in all directions alike, it seeks to expand, and would expand but for physical obstructions which present themselves. The forms that have succeeded in surviving are those, and only those, that were possible under existing conditions; that is, they have been developed along the lines of least resistance, pressure along all other lines having resulted in failure. Now the various forms of vegetable and animal life represent the latest expression of this law, the many possible, and the only possible results of this universal *nisus* of organic being. The different forms of *Eupatorium*, or of any other plant or animal that are found coexisting under identical conditions merely show that there were many lines along which the resistance was not sufficient to prevent development. They are the successes of nature.

Mr. Ward disclaimed any desire to discredit or impair in any way the great law of natural selection. The most important variations, those which lead up to higher types of structure, are the result of that law, which therefore really explains organic evolution; but the comprehension and acceptance of both natural selection and evolution are retarded instead of being advanced by claiming for the former more than it can explain, and it might as well be recognized first as last that a great part—numerically by far the greater part—of the variety and multiplicity, as well as the interest and charm of nature is due to another and quite distinct law, which, with the above qualifications, may perhaps be appropriately called “the law of fortuitous variation.”

August 27, 1889—Ætate 48.

254. Causes of Belief in Immortality

History.—Written April 23 to May 12, and rewritten May 14–17, 1889. I had sent Mr. Metcalf several titles and he selected this one. After reading it some of my lady friends were anxious to know whether I believe in immortality, alleging that the article did not say! The *Forum* for October, 1890, contained a reply to it by J. P. Lesley, at least an article purporting to be such, but the reader will hardly recognize it as such. I certainly do not.

The *Forum*, New York, Vol. VIII, No. 1, September, 1889, pp. 98–107.

Vere scire est per causas scire.—BACON.

THERE has been an immense amount of discussion of the doctrine of a future life, but the attempts to explain on natural principles the causes of the almost universal acceptance of that doctrine are confined to a class of works that are comparatively little read, and which when read are apt to be regarded merely as accounts of the curious superstitions of primitive peoples having no connection with the conceptions of civilized men.

Most believers in immortality, when asked the reason for the faith that is in them, are content to admit that it is based on revelation; but there are some who are ready to give other reasons. Nothing is more common than to hear it said that it is inconceivable that an organization so highly developed as is that of an enlightened human being should perish utterly at the end of the brief span of a lifetime. Although this is no longer recognized as legitimate reasoning, the same cannot be said of the claim which some make that they actually feel an inner sentiment which tells them that they will survive death. But such a reason satisfies only the particular individual who enjoys the

experience. There is, too, no end of objective proofs, inductive and deductive, to the same purpose; but the impartial student of it all usually concludes that these are not the true reasons for this belief, and feels compelled to admit that the chief cause after all is that it has been taught to us, and that each one believes what is believed by others with whom he is associated. But this is very far from saying that there is no good reason for the belief in immortality, and the purpose of this article is not only to show that this belief has its legitimate causes in the nature of things, but also to point out briefly what those causes are.

Science seeks to explain phenomena. It assumes primarily that all phenomena must have their natural causes, and it aims to find the several links in the chain of causation leading up to them. Even a belief may become the subject of strictly scientific study, and the belief in immortality has been so studied, as many think, successfully.

The sense in which it is here maintained that the idea of immortality is a natural one, is that it is a product of man's reason. It is proposed to show that the conclusions drawn from the data at hand to reason from, were legitimate products of the rational faculty in normal action.

But it is not among the more advanced races of men that we must look for the explanation of this belief. Among these it occurs in two quite distinct forms. As understood in what are called civilized countries, namely, as the indefinite persistence of the immaterial part, or soul, of man, which comes into existence with the body, it is accepted by two religious sects, Christians and Mohammedans. In the wider and far more logical form of the continuous existence of the spiritual part of man, not only in the indefinite future but from the indefinite past, it is accepted by the immense populations of southern and eastern Asia. In one or the other of these forms, therefore, the doctrine prevails throughout nearly the entire civilized and half-civilized world. But the study of either of these developed forms of the belief does not furnish an explanation of their natural origin. To find this we must go back to the rudest peoples that can be found. It is not, however, a belief in immortality, in the more refined modern sense, that we here find. It is something far simpler, less definite, and more difficult of comprehension. Travelers among savages have sometimes reported tribes so low, as they state, that they have no idea of a future life; but this has been because, in their ignorance of the savage mind, detecting nothing that corresponded to their own advanced conceptions of the immortal soul, they failed to recognize the true homologue, and indeed the germ itself of these conceptions.

At first glance the ideas of the primitive man belonging to this class present a congeries of varying and apparently conflicting beliefs, so unlike the modern doctrine in question as not to

be recognizable, except by the trained ethnographer, as related to the differentiated conceptions of civilized races. But a careful study of all this mass of primitive thought enables the competent investigator to reduce it to simpler terms, and ultimately to a single principle common to all such peoples, which is a universal conception underlying not only the doctrine of immortality, but all mythology and all religion. This residual principle, stripped of all its changing concomitants, may be defined as simply the notion of spirit.

The real problem, then, is not to account for the wide-spread belief in immortality, but for the universal belief in spirit. How has all mankind come into possession of this belief? Why do we find it, in one form or another, in tribes separated most widely from one another, and in those most completely isolated from the rest of the world? Two answers have been given to these questions. One, that the belief is innate, and belongs to the mind of man the same as his mental faculties; the other, that the conditions which surround a rational being living anywhere on the globe are such as to cause him irresistibly to infer the existence of spirit. The latter answer science accepts.

The primary causes of the belief in a spiritual existence and spiritual beings are twofold, or belong to two somewhat diverse groups. One of these groups of causes may be distinguished as subjective in the sense of affecting each individual personally in such a manner as to lead him to the conclusion that he possesses an invisible or intangible double or spiritual part, which, for a portion of the time, at least, is detached and separated from his original corporeal self. The other group of causes may be called objective, being calculated to lead the primitive man to the conclusion that there are intelligent agencies which are devoid of any material attributes, existing independent of himself and of human beings in general.

To the subjective group belong shadows, reflections, echoes, dreams, delirium, insanity, epilepsy, swooning, trance, and death. It is difficult for the well-informed reader to conceive how utterly devoid the savage mind is of all knowledge of the true nature of any of these phenomena. There is no greater mistake than to suppose that well-developed mental faculties are any help in understanding such things. There is no degree of intellectual power conceivable which, unaided by science, would be capable of furnishing a correct interpretation of any of them. The enlightened world understands them simply and solely because it has been taught what science, in the face of appearances to the contrary, has laboriously investigated and explained.

In contemplating his shadow the savage has no conception of the nature and effect of light. He simply sees his own form, more or less distorted by perspective, without substance, thickness, or tangibility, moving as he moves, and changing its shape

with the altitude of the sun or the angle of the object against which it is cast. He readily perceives that he is the cause of it, that it is in some way a product of himself. He can only conclude that there is something in him, or belonging to him, which can go out and occupy another part of space from that occupied by his real original self—another self, a double, but devoid of flesh and blood, a spiritual nature. And thus we find throughout all mythology, even that of the cultured Greeks and Romans, the terms shadow and spirit inextricably confounded.

When the savage looks into a pool of still water he sees this other self there, only far more distinctly. Instead of being a mere form it now possesses color and recognizable features. Others who see it inform him that all the lineaments are his own. He sees the images of others which agree in all respects with the originals. But when he plunges his hand into the pool there is nothing there. What he sees must be *immaterial*, and this conception does not differ in any essential respect from that of spirit. It is true that animals and inanimate objects also cast their shadows and reflect their images; but every one knows that these, as well as human beings, are endowed by savages with a double existence and a spiritual part. The reasoning is rigidly logical from the premises, far more so than much of the reasoning of the higher races.

The lessons derived from sight are confirmed by those of sound. A chieftain shouts in a mountain gorge and his whoop is repeated from the surrounding hills. It is not an answer; it is his own voice uttering his own words, but from a distant point. He knows that he is not himself far up on the rocky cliff whence the sound proceeds, and yet he cannot doubt that he is its author. It must be his other self through whom he has the power of speaking.

The warrior sleeps, and while sleeping he wanders far away, meets other men and other scenes, performs feats of prowess, or enjoys pleasures never before tasted. He awakes, and every circumstance tells him that he has all this time lain quietly in one place. Yet he recollects all these exploits, and he knows that he has himself experienced them. He is unacquainted with the science of psychology, knows nothing about mind or brain action, and has absolutely no alternative to concluding that the immaterial, but yet feeling, thinking, and remembering part of himself has actually been absent, has seen the objects, performed the deeds, felt the pleasures, and witnessed the events enacted in his dream.

Suppose disease lays him low, fever racks his brain, and he becomes delirious. Again he wanders, experiences, suffers, but he is usually incapable of recalling these scenes and states. He performs strange actions, which are subsequently described to him. Both he and his friends know that he would not himself

have acted thus, and the conclusion is natural that the spirit of another must have entered into and possessed him. Hence we find that everywhere efforts are made in such cases to drive out the evil spirit. Catalepsy, insanity, and all pathologic states fall under this general class, and receive this explanation. And thus it happens, as every one knows, that exorcism is the beginning and the end of the healing art among primitive tribes.

In trance the spirit assumes another state which by practice and fasting may sometimes be voluntarily superinduced, and all the wild forms of ecstasy brought on. This, which does not essentially differ from modern mediumship, is usually explained as the intentional replacing of the proper spirit by another and superior one. But the trance in the medical sense, and in so far as they differ, the swoon or syncope, imply the complete temporary abandonment of the body by the soul. The latter is supposed to go away, and there is usually nothing to indicate where it has gone or what it is doing. The inference is common that it has gone to take possession for the time being of some other body.

But swoons, and especially cataleptic trance, may have considerable duration, and the transition from this to death is, to the savage mind, very easy and natural. Death is simply a permanent swoon. The double has gone, this time never to return. Where has it gone? This question is variously answered, but in most tribes of low rank the idea of any distant abode for these departed spirits is entirely wanting. They are usually supposed to remain near the spot where they left the body or where the body is finally placed, and an immense number and variety of mortuary and burial customs attest the universality of this general belief. These all point to one notion common to all races, namely, that of the continued existence after death of the incorporeal part of man.

Here we have a complete genesis of the universal belief in spiritual existence and a satisfactory explanation of its universality. It ends the controversy between those, on the one hand, who claim that belief in a future life is universal and must therefore be innate, and those, on the other, who deny such universality. The premises of the former are practically sustained, but in such a manner as to disprove their conclusion, while the claim of the latter is shown to be opposed to the facts. The simple truth comes forth that the universal belief in a life after death is a necessary conclusion which the primitive man must draw, as soon as he can reason at all, from the phenomena which nature always presents. The universal belief in an after-life is due to the simple fact that from identical phenomena the reasoning faculty, which is everywhere the same, will uniformly deduce the same conclusion.

The idea of the survival of individuals that die could not fail

to exert a profound influence upon the living. Conceiving, as savages usually do, that the spirit remains near the scene of its career during life, they could not stop short of peopling every spot with innumerable spirits. With few exceptions these spirits are regarded as evil-disposed, and to them are attributed most of the misfortunes that befall the living. All space thus becomes filled with myriads of spiritual beings, the *manes* of departed men, and these have been feared, worshiped, implored, and propitiated under a variety of names.

This, too, furnishes an explanation, satisfactory to the savage's mind, of many of the mysterious phenomena of nature. Unacquainted with the operation of natural forces, he had, as we shall see later on, accounted for all movements in the inanimate world on the principle of an indwelling consciousness, and now, with the vast accumulating hosts of liberated human doubles, there is no lack of material for animating every object in nature. We thus have a rational basis for fetichism as well as for animal-worship.

A still more important consequence of this belief is that which follows on the death of any great chieftain or mighty ruler. The souls of such men also persist. They, too, linger round the places of their glorious achievements, and are the invisible spectators of the doings of their former subjects. What must be the effect of such a belief? For a while elaborate ceremonies are performed over the tomb of the dead hero. His weapons are usually buried with him to arm him in the next life. His possessions are frequently placed in his grave to be used again; too often slaves and even wives are sacrificed to accompany him and minister to his wants. As time goes by his earthly exploits are more and more exaggerated, until they all become marvels and miracles. Complete apotheosis is the ultimate result. This takes the form of ancestor-worship, from which it is not a long step to the worship of beings not conceived as of human origin.

The above are fair samples of the subjective influences which have led the primitive man to a belief in the existence of spirit, of a spiritual part in man, and of spiritual beings in general. They might in themselves seem adequate to account for such a belief and for its universality; but to them we have now to add the causes which I have distinguished as objective, strengthening and confirming the subjective causes, and swelling the stream of evidence poured into the receptive mind of untutored man.

Early ideas are necessarily anthropomorphic. They are based on the individual's experience of his own powers. The most fundamental of all such experiences are those connected with the power of spontaneous movement. The savage's idea of life is ability to move, and whatever moves without known external force is supposed to be alive. Hence, one of the first results of human reasoning is to attribute life to certain inanimate objects.

The activities of inanimate things are, moreover, generally conceived as conscious and intentional—as manifestations of intelligent will. Akin to this conception is that of the presumed power of metamorphosis which a certain class of phenomena early led primitive man to ascribe to almost every object in nature. Not only can material objects move, but they can also change, become other things, vanish, and dissolve entirely, ceasing longer to exist, or they can reappear at will in the same or some altered form and guise.

When we say that early man reasons logically, it must not be inferred that this has anything to do with the recognition of the laws of causation as understood by scientific men. He indeed requires and insists upon a cause, but it is rarely a true cause or *causa efficiens*. It is usually a final cause, and the *causa finalis* is amply adequate for his purpose. He always demands a reason, but it is rarely or never what is technically called a sufficient reason, the *ratio sufficiens* of the schoolmen or *zureichender Grund* of Kant and Schopenhauer. Yet the efficient cause is the only cause, and the sufficient reason is the only reason that modern science recognizes; and this is coming to be so well understood that it has become customary to call that a logical mind which insists upon a strictly mechanical antecedent for the explanation of every phenomenon. This is not the primitive sense of either the term logical or rational, and it is not the sense in which it can be applied to the aboriginal mind of man. The recognition of a will to move or a will to change is all that most minds, even among somewhat advanced races, require; and the great weft of mythology and folk-lore of such races—the “Arabian Nights Entertainments,” the Ossianic poems, and the mass of mythic lore and legend that makes up the early literature of every cultured nation, with its diluted and degenerate remains that are taught to our children in the nursery, and the ease and interest with which it is all absorbed by the latter—amply attest the adequacy of what may be distinguished as the logic of magic for all minds not thoroughly trained by prolonged familiarity with science in the logic of law.

The power of natural objects to change their form at will is constantly forced upon the mind of early man. The formation and dissipation of clouds; the succession of daylight, darkness, and the seasons; the changes of the moon; the wanderings of the planets; the apparent revolutions of the sun, moon, and stars; the phenomena presented by comets, meteors, auroras, rainbows, lightning, halos; the slower processes of vegetable and animal growth and decay; the emerging of birds from eggs, of moths from chrysalids; indeed, the phenomena of reproduction in general, as well as of life and death—all these must have rendered the conception of indefinite transmutability at will throughout all nature a familiar one to the savage mind.

The manifestations of apparently inherent power in nature through earthquakes, tornadoes, and thunderbolts, forced these ideas home with a terrible sanction. The most typical of all these influences is that of wind. It is the embodiment of power without visible cause. The savage never thinks of air as a material substance. To him it is simply a manifestation of will—the expression of a purpose or wish by a spiritual agency. Hence the frequent identification of the terms wind and spirit (πνεῦμα).

The savage knows nothing of causes except as they are exemplified in his own muscular actions. With this narrow induction he can only reason that all effects are produced by such causes. His reasoning is in all cases teleological. Not a leaf trembles in the breeze, not a wave washes the shore, but that in his mind it is the result of will. Eolus and Neptune are but the refined embodiments, in a more civilized people, of these crude primitive conceptions. All the imaginary beings conceived as exerting this will-power are highly anthropomorphic in their character, and differ from the spiritual part of man only in being detached from the animal body.

The reader will not, of course, expect, in a short article like this, that the multitudinous facts upon which each several proposition is based will be stated. For these he must go to the great stores of such knowledge that have been accumulated by Tylor, Lubbock, and Spencer, in England, and by Schoolcraft, Morgan, and Powell, in the United States, not to mention the French and German ethnographers.

It would seem, then, that overwhelming evidence, both of the subjective and the objective kind, exists to show that a rational being placed in a world like this must necessarily conclude that there is such a thing as spirit—an invisible, intangible, conscious power, not occupying space, and wholly independent of the conditions that restrict the actions of embodied beings. Not less irresistible are the proofs that the intelligent, conscious motive power of bodily action in each individual is in fact such a spirit, and is capable, under certain circumstances, of quitting the body for a longer or shorter period, of entering another body temporarily or permanently, or of abandoning the body altogether.

As already remarked, this is the chief point to be established. The passage from such a belief to a belief in immortality is exceedingly simple and natural. From the notion of a temporary continuance of the spiritual life to that of its permanent continuance, is but a step; and, in fact, as soon as thought about, it becomes a necessary step, since the spiritual part is naturally conceived as indestructible. The ideas that grow up with regard to metamorphosis in nature, coupled with the belief that animals, too, have spirits, account in a satisfactory manner for the origin of the doctrine of transmigration of souls; while the lopping off

of that highly rational accompaniment merely shows that, upon such questions, even the most advanced peoples of the modern world are not yet troubled by the absence of a *ratio sufficiens*.

Finally, the probable absence of the notion of a continued personal existence among the Hebrews, Greeks, and Romans, must be explained on the theory that in gradually sloughing off the adjuncts of savagery, those nations discarded this idea as essentially barbaric. This, however, did not carry with it the rejection of the fundamental conception of spiritual existence, which persisted in the form of gods, anthropomorphic, it is true, but wholly incorporeal—a pantheon of great and powerful spirits.

October, 1889—Ætat. 48.

255. The Sociological Position of Protection and Free Trade

History.—Rough draft written under the title *Protection as a Theory*, Nov. 9, to Dec. 7, 1888. Rewritten under the above title Dec. 9, 1888 to Jan. 8, 1889. Read before the Anthropological Society of Washington Jan. 8, 1889. I offered it to the *Forum*, but it was not accepted, perhaps because Mr. Metcalf had pronounced opinions opposed to it. Its natural place was in the *Anthropologist*, and after considerable more revision and improvement it was submitted on May 20. My reprints were sent me nearly two months in advance of the October number, viz., on Aug. 16.

I confess that the political campaign in which the protection policy was restored under Harrison and a deficit converted into a surplus, had much to do with turning my thoughts in the direction of this article. But I aimed to show that the social effects of protection are much more important than the fiscal effects.

The American Anthropologist, Washington, D. C., Vol. II, No. 4, October, 1889,
pp. 289-299.

IF there is a social science, there is no social movement which cannot be referred to some principle of that science. The banks of foam and clouds of mist that the two tenets known as Protection and Free Trade have raised on the sea of American politics must be the result of powerful undercurrents of social and industrial activity, and it is these alone that are worthy of our serious attention.

The essential attribute of a science is the existence of a group of phenomena which are uniform under like conditions. The effects

of these phenomena are then called natural forces, which also are uniform and reliable. In the physical world, and, so far as known, in the world of life this holds true, and the question as to whether there is any such science as sociology depends upon whether it holds true also in the social world. Here is not the place to discuss this question, and I shall assume that sociology is a true science, and that society is a theater of true natural phenomena and forces, though these are admitted to be highly complex, obscure, and as yet very imperfectly understood.

From the point of view of the value of science to civilization it is readily seen that in the physical world it has first been necessary to learn the laws of phenomena and the nature of forces and then, by the aid of this knowledge, to control such phenomena and forces, and render them subservient to human needs. In the social world, it is clear that the same steps must be taken before the science of sociology can be of any use to man.

In the light of these general statements I will now attempt to explain the scientific position of both Protection and Free Trade, as these terms are currently understood, and to relegate each to its proper group or class of sociological conceptions. In so doing I shall be obliged to dwell somewhat more upon protection than upon free trade, because the former is a far more complicated principle, and from a theoretical point of view very imperfectly understood; while the latter has been taught in most institutions of learning from time immemorial, not merely as a policy, but as a theory, and ought, at least, to be thoroughly understood. How superficially it is really understood I shall hope to show.

It has always been maintained on the one side, and scarcely denied on the other, that in theory the doctrine of free trade is invincible, and the fact that most chairs of political economy teach it, and most scholars accept it, even in this country, is pointed to as an illustration of the power of a theory, or abstract principle, even when it seems to contravene so many interests. Aside from the question whether an alleged principle can be sound from an economic standpoint which obviously opposes such large interests, it is perhaps time to return to so-called first principles and hazard the inquiry whether protection may not also be defended upon theoretical grounds, and whether it, too, may not rest on a principle of economics capable of being formulated in thought.

I maintain that there is a theory of protection, and I propose in this paper to condense into as narrow compass as possible the statement of this theory and of its true relations to the theory of free trade.

The theoretical protectionist and the free trader both start from the same postulate, viz., that the test of soundness in a principle is that its application results in the general good of human society in the widest sense. The free trader claims that

his theory is cosmopolitan, that it reaches beyond the narrow limits of petty states or separate nationalities and takes the whole commercial world into its beneficent embrace. He charges the protectionist with advocating a policy which, if beneficial to any one, is so only to the people of his own country, who are benefited at the expense of other people. He may admit that protection helps to make a nation self-sustaining and independent of other nations, but he insists that this is not only a narrow and semi-barbaric policy, but one which has really to be paid for by the protected people, since the duties levied upon foreign articles must be paid by the consumer whether he consume these foreign articles or the domestic ones the production of which is due to protective duties. The reasoning certainly seems sound, and, studied as a maxim without reference to the market, the theory of free trade appears to commend itself to all logical minds. The chief law that it presents to the student is that with reference to redundant transportation, and in the college lyceums the question is perpetually being debated whether it can be really economical to transport raw material across the Atlantic and then bring it back again in the form of a finished product, even though that product cost less to the consumer by such double transportation. To some unsophisticated sophomores there seems to lurk a fallacy in the assumption that this is true economy.

In considering a theory of protection it should first of all be observed that a protective tariff is only one of a large class of means which not only states but corporations, institutions, and individuals adopt to secure a certain end, viz., to encourage activities that are supposed to be beneficial to society. Few will deny that it is both a right and a duty to adopt any means that can be proved to be for the general good. The common principle which embraces all forms of protection is that of the subvention or bounty. It does not differ in any essential respect from the prize. The theory of prize-giving may be, and doubtless sometimes has been, carried to excess or applied in cases where it has worked more evil than good, but upon the whole it has proved one of the most productive sources of well-directed activity. Institutions of learning, in which we may assume that the most enlightened attention has been given to such questions, have very generally adopted some form or other of the prize system. The only evil that is ever complained of as resulting from this practice is that of supplying an undue stimulus and causing a dangerous degree of intellectual activity in immature minds. This is itself the strongest certificate of the success of the principle, and only proves that like all powerful agencies it must be employed cautiously and with judgment.

Whenever the state has applied this principle it has always proved effective. I do not say that it has always been beneficial. That depends upon the wisdom of the legislature. But if the end

sought has been a useful one the policy has proved sound. The offering of bounties for the successful accomplishment of objects admitted to be desirable has already proved highly successful, and should it be generally resorted to by governments as a means of removing great social evils and securing valuable inventions, I have no doubt it might become a powerful engine of civilization. As yet, however, governments have resorted to this principle only in certain great emergencies, and then it has been given special names which have the effect of masking its real character. In fact, it must be confessed that legislators have not grasped its full import. They have not understood its true nature. They have always treated each case specially and by itself, without attempting to refer it to any higher general principle. They do not see that the subsidy they have voted to a railroad enterprise, the bounty they have granted to a steamship company, and the protective duty they have imposed upon a certain article which can be manufactured at home, are all acts of essentially the same nature, and that they do not differ in any general respect from an act to award a prize to the discoverer of a remedy for yellow fever or to the inventor of the best fire-escape. There are some narrow-minded people who oppose all such measures on the ground that public money is thus given to private individuals. But if the results are regarded as of value to the country at large, I can see no difference between this and the payment of salaries to the officers and employés of the government for the transaction of its necessary business. If the end is not a desirable one, then the legislation is unwise and to be classed along with the creation of sinecure offices. As a matter of fact, however, the end is usually regarded as of the greatest value, and if attained it is supposed to justify almost any expenditure.

The principle, then, to which all such legislation belongs is that of inducing individual members of society to put forth exertions which are foreseen to be beneficial to society at large. Elsewhere I have characterized this as "attractive legislation" in contradistinction to the predominant mandatory, prohibitory, or coercive legislation. The former enforces itself, the latter requires a large number of officers, courts, lawyers, constables, posses, and policemen, and involves heavy expense in its enforcement. In the former the result is as certain as the succession of day and night; in the latter it is never certain and rarely complete. In the former, the effect is to inspire respect on the part of the people for their government and love of their country; in the latter, government is made odious and the state becomes an object of hate and suspicion.

If we define sociology as the science which treats of the laws of social action, we may consider attractive legislation as an attempt to deal with the social forces in precisely the same manner as the physicist deals with physical forces, with a view to their control

and utilization. Comparing the law according to which men will always seek the greatest gain to the law by which water will always flow toward a lower level, there is no difference in principle between an act of government which makes it a gain to do what is useful to society and an act of an individual which deflects a stream of water into a useful channel, whether it be an irrigating ditch, a mill-race, or a canal. The two acts are, scientifically speaking, identical. But the latter act is only a simple case of the economical employment of a natural agent, and all material progress has resulted from the multiplied repetition of such cases in the more or less complete subjugation of nature to human needs. The forces of nature have been controlled by intelligence acting upon phenomena, and attractive legislation differs from all other modes of controlling natural forces only in dealing with social phenomena. There are no social impulses that are essentially bad, none that may not be made to work for good by simply discovering and applying successful methods to this end.

The great economic principle is that civilization depends entirely upon the intelligent control of natural forces, including the social forces, and their direction into channels of human advantage. These forces left to themselves always run to waste, often become hostile to man. Such is the case with fire, water, steam, wind, electricity, etc. It is only by controlling, regulating, and directing them that they become the servants of man. The same can be shown to be true of the vital forces in vegetable and animal life. The valuable products of either kingdom are those which have been brought to perfection by thought, labor, and skill. It is also true of the social forces which have proved susceptible of control, regulation, and intelligent direction through the application of the same principle as that which has reduced the rest of nature to subjection.

It is only very rarely that states have made use of this strictly inventive principle in controlling the complex forces and phenomena of society. Rulers and legislators have generally found no better way to secure what they regard as useful ends than to command the people to do certain acts and punish them if they do not. But there are a few cases where states, especially in more modern times, have devised other means to secure their ends, means which embody to a greater or less degree the scientific principle of invention. Much ingenuity has always been employed in obtaining revenue at the least expense and friction, and the imposts that were formerly collected upon goods in transit from one part to another of the same country were the origin of the term *laissez faire*, which has now become the rallying cry, not only of those who favor free trade, but of the whole school of philosophers who call themselves individualists. The system was vicious because the end was bad, but as a means of raising revenue it was successful. The same system was exten-

sively applied to trade between different countries, and though still worse in principle it was more successful, because foreign countries had no right of petition. Strange to say, it is this same vicious system of restricting trade for the sake of raising revenue that is to-day defended in this country, and, still stranger, defended by those who, in varying degrees, are advocating free trade. For a "tariff for revenue only," which is a watchword of one of our American parties, is nothing else than a plan of raising revenue by restricting trade. Properly viewed, those who advocate a tariff for protection only come much nearer to being free traders than those who advocate a tariff for revenue only, and when the question of the relative justness of the different modes of taxation is considered, the tariff for revenue proves the most unjust that can be adopted short of the simple poll-tax; for it is only when duties are levied upon articles that cannot be produced in the country that levies them that it really becomes true that "a tariff is a tax." It is proved by the history of American tariff legislation and that of prices that a tariff for protection not only is not a tax, but that it is often a means of reducing prices and preserving a healthy competition. Illustrations are abundant, and the mere mention of American watches, steel rails, and woolen goods is sufficient. All of which is entirely independent of the other paramount advantages which a state can secure by a wise and judicious strictly protective tariff.

Resort to a tariff for protection was had much later than to a tariff for revenue. As statesmen became wiser and more farsighted they began to perceive that by regulating trade so as to keep out products that can be obtained at home, the resources of their respective countries could be developed and nations rendered self-sustaining and independent. This national sentiment was the principal motive in securing the adoption of protective tariffs, and it is undoubtedly still one of the leading motives. A statesman is not a humanitarian, but the history of this movement has proved that with states as with individuals those acts which are performed in self-defense are usually the ones that best conduce to the collective weal.

Experiment soon showed that this ingenious economic device, as it may be called, not only brought revenue to the treasury and independence to the state, but prosperity to the people. By it the very character of the population of a country may be changed and an almost exclusively agricultural people may be transformed into a people of multiplied pursuits, each individual ministering to the needs of all the rest. From a dull and monotonous life of Arcadian simplicity the same community becomes awakened into physical and mental activity, and industry, traffic, and trade fill the country with all the characteristics of a free, enlightened, and enterprising nation. Of all the means that have thus far been hit upon by statesmen for the beneficial

modification of social phenomena and the attraction of human activities into advantageous channels, that of the protective tariff has proved the most successful and far-reaching in its effects.

Such being the theory of protection, I propose next to contrast it with that of free trade. Free trade does not, any more than protection, constitute a general economic principle; it is only one of the applications of such a principle. That principle itself, as already remarked, is what is now expressed by the term *individualism*. It is perhaps still better known by the French expression *laissez faire*, called in English the let-alone policy. The origin of this phrase is to be found in De Gournay's celebrated maxim "laissez faire, laissez passer," launched against the pernicious policy of his time, of government interference in the business interests of the people, and the obstruction of trade by the imposition of odious tariffs for revenue, not only on foreign but on domestic merchandise. The second term of this maxim, *laissez passer*, is the exact equivalent of our expression, free trade. The first term, *laissez faire*, has been expanded into the generic notion of governmental non-interference in social affairs, and in this sense it includes free trade and is equivalent to individualism, the ultimate limit of which is anarchism, the extreme logical opposite of which is socialism. Everybody, except the socialist, believes in a certain amount of free trade and in the greatest freedom of social action consistent with the rights and liberties of all. An excellent rule would be never to interfere with business or trade unless the good of society can be clearly shown to justify it; and by the side of this should be placed the additional maxim never to interfere by force where an inducement can be held out that will secure the desired end.

But in order fully to understand the economic principle of *laissez faire* and free trade we must, as in the previous case, make the instructive comparison of social with physical phenomena. We must keep firmly in mind the fact that the control of natural forces is what has created human civilization; that every industrial art rests upon the interference of man with the natural flow of wind, water, and other agencies; and that all that man does and is which distinguishes him from the brute creation has resulted from his wholesale and high-handed violation of the principle of *laissez faire*. And remembering that social phenomena differ from other natural phenomena only in their complexity and difficulty of management, it becomes clear that all real economic progress must result from the intelligent interference with the natural flow of the social forces. Their great complexity is what causes all the lively competition of which we hear so much. Free competition, it is said, is the most healthy and economical condition possible. But it may almost

be questioned whether there is any such thing as free competition. It is in the very nature of competition to arrest the free play of activities. The term itself implies friction and the choking of rival interests. What is called free competition is necessarily only a temporary and transition state. It is a condition of unstable equilibrium which tends steadily and rapidly toward the stable condition. Such stable condition is one of rest, the cessation of all activities, and this is the end toward which all unregulated competition moves. It requires intelligent interference to preserve competition free, or, more correctly speaking, to *prevent* competition, so as to leave useful activities free. If we analyze the facts closely enough we find that this is exactly what human ingenuity accomplishes in the mechanic arts. The tortuous windings of a river are the result of its competition for a channel of least resistance. Intelligence destroys this competition by creating such a channel and utilizing the water previously running to waste. Every mechanism, every art, and every industry involves this principle, and all the efforts of man have been directed toward the destruction of the friction of competition in the forces of nature and the liberation of motion to be guided into productive channels. Left free, these forces tend toward the condition of rest; all motion is arrested and all result precluded. It is so in the social world. The social forces when left to themselves tend to bring human progress to rest. Free competition in the industrial world leads to strife, rate-wars, combinations, trusts, monopoly, and ultimately to cessation of industrial activity. Free trade in like manner produces all the friction of other forms of competition. Nations compete for the commerce of the world, and gradually some one, like Great Britain, will come to command the seas. This becomes a great commercial monopoly, and all the evils of monopoly attend it. It causes the centralization of elaborative industries at a few points and abandons the rest of the world to the production of raw materials and food supply. Certain countries are forced to become almost exclusively manufacturing and commercial, while others must devote themselves almost exclusively to agriculture and mining. This is a disadvantage to all. Such a monopoly has the power to compel the transportation of vast quantities of heavy materials, such as iron and other metals, twice across the ocean before they can be made use of in the finished state in the country where they are mined. The manufacturing countries become dependent upon the agricultural ones for the means of subsistence, and the agricultural upon the manufacturing for implements and appliances, while the commercial intermediaries are enabled to demand almost any price for their indispensable services. This explains how the adoption of a protective tariff by the United States has had the effect in so many cases of reducing the price of commodities. Steel rails were thus reduced from

sixty-three to twenty-eight dollars per ton by a duty equal to the present price.*

The narrow theory of the free traders is wholly inadequate to explain such facts, and they can only be explained upon the broader general principle which I have laid down. It has often been observed that in mechanical contrivances the effect is vastly disproportionate to the cause. The Archimedean lever is the type of all the results of human ingenuity. When men shall learn to control the social forces by the exercise of ingenuity, as they do these mechanical forces, the same disproportion between causes and effects will be observable. Such disproportion is a fair test of the true inventive character of any legislative act. Protective tariff legislation comes as near to this class, perhaps, as any that has been adopted, and the failure of the free trade economists to understand its effects is due to their entire ignorance of this fundamental principle. They fail to distinguish between protective and non-protective tariffs, and all their arguments apply only to the latter class. Free trade and protection are not antithetical terms. The opposite of free trade is restricted trade, trade fettered and obstructed by revenue tariffs. The protective principle is not at all involved in this. The protective tariff certainly does affect trade. Its effect is much greater than that of the non-protective tariff. When wisely applied it completely alters the current of trade in the commodity protected. It prohibits trade, *i. e.*, the unnecessary transportation of goods that can be produced near the consumer. This is a great economy. At first it usually increases the price of the protected article, but in the end it reduces it by the whole cost of this redundant transportation, often by much more than this. This is made possible by its effects in destroying foreign monopoly of both manufacture and transportation. It even goes so far as to reduce the price abroad. Another of its unlooked-for effects is that of raising and sustaining wages. The theorists hold that with the imposition of protective duties prices and wages must rise together and exactly balance each other. The facts show that prices sustain a temporary rise and then a greater permanent fall, while wages rise out of all proportion to the highest rise in prices and do not tend to fall. This is because a strictly inventive principle has been applied to a class of social forces resulting in an effect disproportional to the cause. Other illustrations of this most

* In 1863 Naugatuck arctic overshoes sold at 78c. a pair. The same shoes are now sold at 42c. Wages of hands in same shop in 1863 were from \$5 to \$6 a week; they are now \$11.

The Willimantic Linen Company in 1859 made a three-cord thread, 200 yds. to the spool, at 42½ c. per doz. The tariff on such thread was made practically prohibitory. In 1887 the same company sold the same thread, improved in quality, at 18c. per doz. In 1863 the pay of employes averaged \$187 per annum. In 1887 it averaged \$373 per annum.

fundamental of all sociological principles might be given, but those already stated must suffice.

In conclusion, then, it may be said that from the sociological standpoint free trade, *laissez faire*, and individualism in general represent the untamed forces of nature, such as would exist in the physical world had there never been any inventions, contrivances, machinery, or arts—forces which naturally seem hostile, and which to the uncivilized man are in the main hostile to his existence. On the other hand, protection belongs to the great class of ingenious instrumentalities which the civilized brain of man has learned to devise and employ for the regulation, control, and utilization of natural agencies, even to the desires, appetites, and passions of men, from which, as from all the other elements of nature, the race has always stood in sore need of protection. It does not differ in principle from the various means by which he has protected himself from wild beasts, vermin, fire, flood, and storm. Trade, if too free, may be an enemy as much as tigers, flames, or water; but properly guarded, every power in nature becomes both friendly and useful to man.

November, 1889—Ætat. 48.

256. Notice of Jurassic Plants from Kaga, Hida, and Echizen (Japan); by Matajiro Yokoyama. Journal of the College of Science, Imperial University of Japan, Vol. III, Part I, Tokyo, Japan, 1889

History.—Written Oct. 16, 1889.

The American Journal of Science, New Haven, Conn. Third Series,
Vol. XXXVIII [Whole Number CXXXVIII], No. 227,
November, 1889, p. 414.

December, 1889—Ætat. 48.

257. Notice of the Tertiary Flora of Australia; by Dr. Constantin, Baron von Ettingshausen. English translation, edited by R. Etheridge, Jr., Sydney, 1888

History.—Written Oct. 2-4, 1889.

Ibid., No. 228, December, 1889, p. 493.

January (?) , 1890—Ætat. 48.

258. Report on the Department of Fossil Plants in the U. S. National Museum, [for the year ending June 30], 1887

History.—Written in July, 1887.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1887, Part II, Washington, 1889, pp. 145-146.

January (?) , 1890—Ætat. 48.

259. Report on the Department of Recent Plants in the U. S. National Museum, [for the year ending June 30], 1887

History.—Written in July, 1887.

Ibid., pp. 147-148.

January (?), 1890—Ætat. 48.

260. Bibliography for the Year Ending June 30, 1887

History.—Written in July, 1887.

Ibid., p. 593.

LESTER F. WARD. [Report on the] Department of Fossil Plants
[in the U. S. National Museum, 1884].

Report Smithsonian Institution, 1884, II (1886), pp. 219, 220.

—— Broadening the Way to Success.

The Forum, New York, II, December, 1886, pp. 340-350.

Condensed from a lecture delivered at the National Museum, May 1, 1886, on "Heredity and Opportunity." It is argued that undue attention is paid to genius and too little to the extension of equal opportunities to all.

—— The Use and Abuse of Wealth.

The Forum, New York, II, February, 1887, pp. 549-558.

Some of the ways in which persons of ample means might profitably employ it are pointed out, and the use of wealth as an aid to thorough and efficient work is suggested as a partial solution of the question of restricting fortune.

—— Science and Immortality.

The Christian Register, Boston, LXVI, April 7, 1887, pp. 211, 212.

Contribution to a "Symposium" of scientific men on the subject of the title. The article was copied in *Public Opinion*, Washington, III, April 16, 1887, and the Symposium has since been issued in pamphlet form.

—— The Immortality that Science teaches.

The Open Court, Chicago, I, May 26, 1887, pp. 199-201. One of the propositions contained in the preceding contribution is here more fully expanded.

—— False notions of Government.

The Forum, New York, III, June, 1887, pp. 364-372.

Some of the current fallacies respecting the powers and duties are exposed in this article and the direction in which state functions should be enlarged is pointed out.

LESTER F. WARD. Administrative Report to the Director of the U. S. of Geological Survey of the operations of the Division of Paleobotany for the year ending June 30, 1885.

Sixth Annual Report of the U. S. Geological Survey, 1884-'85. Washington, 1885, issued June, 1887, pp. 81-85.

—— Synopsis of the Flora of the Laramie Group.

Sixth Annual Report of the U. S. Geological Survey, 1884-'85. Washington, 1885. Extras, Washington, 1886, issued June 1887, pp. 399-557, pls. xxxi-lxv.

Contains an historical review of opinion relative to the age, the nature and extent of the groups and of the vegetation of the Laramie Group, an extensive table of distribution of Laramie, Senonian, and Eocene plants, and a thorough discussion of the same. Concludes with a report upon recent collections from the Laramie Group, especially the results of the author's personal studies in Colorado and Wyoming, in 1881, and on the Lower Yellowstone and Upper Missouri (Fort Union Group) in 1883, still in process of elaboration, giving a list of 140 species identified at that date, 85 of which were new to science. These 140 species are illustrated on 35 double plates, containing 409 figures, by the photo-engraving process. No descriptions nor discussions of the botanical affinities of these fossil plants accompany the list of names and illustrations, these being reserved for the publication described under the next title.

—— Types of the Laramie Flora.

Bull. of the U. S. Geological Survey, No. 37, 354 pages, 57 double plates, 8vo, Washington, 1887.

The figures published in the "Synopsis of the Flora of the Laramie Group" (see last title) are here reproduced on smaller plates, and are preceded by 115 pages of letter-press devoted to their thorough systematic description, with synonymy and full discussion of the relationships of the species.

January, 1890—Ætat. 48.

261. Notice of Contribuzioni alla Flora Fossile dei Terreni Terziarii della Liguria; by S. Squinabol. I. Fucoidi ed Elmintoidee, Roma, 1888; II. Caraccee-Felci, Genova, 1889

History.—Written Nov. 23-25, 1889.

American Journal of Science, New Haven, Conn., Third Series, Vol. XXXIX [Whole Number CXXXIX], No. 229, January, 1890, pp. 72-73.

February 24, 1890—Ætat. 48.

262. Administrative Report of the U. S. Geological Survey, Year Ending June 30, 1887

History.—Written June 22–24, 1887.

Eighth Annual Report of the U. S. Geological Survey, 1886–87, Part I, Washington, D. C., 1889, pp. 184–188.

February 24, 1890—Ætat. 48.

263. Geographical Distribution of Fossil Plants

History.—Written March 4, to July 19, 1887. Withdrawn and revised Dec. 27, 1887, to Feb. 8, 1888. As stated in my *Sketch of Paleobotany* (see supra, p. 26, No. 208), the historical and bibliographical matter was there brought down only to the year 1850. This paper was intended to take up that aspect of the subject and bring it down to date as nearly as practicable. But when I commenced to collect materials for a second contribution to the *Compendium of Paleobotany*, which was on Jan. 6, 1887, I had something more general in view. I was going to discuss some of the leading problems of paleobotany, and I accordingly called the second paper *Problems of Paleobotany*. On Feb. 5, I received my regular invitation to contribute to the next *Annual Report*, which would be the 8, and I decided to do so and write this article. By the end of February I had compiled a large amount of historical and bibliographical data, and on March 4, I com-

menced writing it up, still calling my paper *Problems of Paleobotany*. I soon found that the first "problem" was to learn where the fossil plants known to science had been found, and the work gradually narrowed down of itself to that question. On April 12, I resorted to dictation. I had a very bright lady assistant, who had come as an artist, but was not a skilled draftsman, and who was willing to do any kind of work. She was not a stenographer, but could write long-hand about as fast as I cared to dictate in a work of that kind. I had drawn up a list of countries and arranged them in a sort of logical order, and these I took up in that order and treated them as in the memoir. Each day's progress was recorded in my note-book. I began with North America and reached the United States early. This order was subsequently changed and the United States put last. The work was interrupted during the last half of May by my visit to Boston to attend the meeting of the American Economic Association. It was resumed on June 1, and we got through all the States on the 19. I then went back and introduced a large amount of matter that had been found in the meantime, and on the 23, I commenced the preparation of the map. I found I could intrust the most of this work to Mr. David White, and I returned to the manuscript and wrote up the European countries, beginning with England on the 23. The order seems to have been: Great Britain, France, Spain, Portugal, Italy, Greece, the Austrian provinces (Dalmatia, Croatia, Styria, Hungary, Bohemia, Austria proper, Carniola), Switzerland, the German states (Alsace-Lorraine, Saxony, Silesia, Baltic Prussia, Rhenish Prussia, Hesse), Belgium, the Netherlands, Denmark, Norway, Sweden, Russia. Europe was finished on July 18, and I took the paper home and revised it there, as I had done for the United States.

Mr. W. J. McGee, who had some sort of charge of the Survey publications, informed me on July 9, that I probably could not get my paper into the *Eighth Annual Report*, as it must go to press immediately, and proposed to substitute for it a paper by Mr. Edward Orton on gas wells. I was much chagrined, as I had been rushing matters at railroad speed, and there never had been any such haste before with the *Annual Reports*. The next day, however, he proposed another alternative, if I would forward at once all that was written. This was done on the 12,

and included the whole of the United States with the map. On the 18, the Chief Clerk informed me that my manuscript had not yet gone to the printer, and that Mr. McGee's "railroading" methods were not approved. On the 19, I sent in the balance. There was much still to do on it in the way of interpolating new-found data and adding references, but the manuscript had been typewritten in duplicate, and I proceeded to make these additions in the second impression, with a view to using them when the proofs should arrive. On the 28, I left for the field to visit the Yellowstone National Park, and did not return till Sept. 22.

On Oct. 24, 1887, I was asked to contribute a paper to the Philosophical Society of Washington, and I decided to talk on *The Geographical Distribution of Fossil Plants*. I condensed portions of my manuscript, gave up trying to compass the whole world, and concluded to confine myself chiefly to the United States and discuss the map. It was read, or rather begun, on the 29, but I was at the end of the program and had only 20 minutes. I said all I could in that time and called attention to the map. I did not suppose I could get the map, and expected to use the carbon copy of the manuscript, but to my surprise, notwithstanding Mr. McGee's strenuous policy, I found that everything was still in the Editorial Division of the Survey, quietly reposing there while other papers were being edited. I withdrew it all with a view to revising it thoroughly. But I had other work and did not commence the revision till Dec. 27. I then took it up systematically and made thorough work of it, not completing it till Feb. 8, 1888.

On March 30, 1888, Mr. Henry Gannett read a paper before the National Geographic Society on a *Proposed Physical Atlas of the United States*. I was among those who discussed his paper in ten-minute speeches, and I confined my remarks to the geographical distribution of fossil plants, referring to my map of the localities. I have no idea what I said, but I wrote in my diary that "I made some witty remarks that were evidently enjoyed."

The manuscript seems to have lain in the Editorial Division until July 26, 1888. Our accomplished editor, Mr. Thomas Hampson, had died in the meantime, and Mr. W. A. Croffutt was appointed in his place. On the above-named date the latter informed me that I could have the manuscript to give it a final revision, and on August 2, it was sent me for the purpose.

I was glad of the opportunity, because such a paper is always capable of being improved and perfected. I suppose this was completed and the manuscript returned before I left for Cleveland on Aug. 12, to attend the meeting of the American Association for the Advancement of Science, but there is no record. On Oct. 5, I received a proof of the map, which I carefully corrected and returned the next day. Proof of the letter press did not begin to come till Jan. 22, 1889. The reading and correction of the proof was a long and tedious task. A great deal of new matter was added. It was not all in type till near the middle of May. By June 13, a large part was in pages, and I instructed one of my lady assistants to commence the preparation of the index. It was not finished, when I returned from a trip to Martha's Vineyard on the 24, and I then pushed that part of the work, so arranging that the entire force, then of six or seven clerks, could work at it simultaneously. It was finished and sent in on July 15. On Aug. 17, proof of the index began to come. I discovered that in preparing the index my assistants had failed to index the footnotes. These all had to be added to the galley proof. In making the index and correcting the proofs of it a large number of discrepancies was discovered. I made a list of these on Sept. 2, and sent them in as plate corrections. Most of them were made. It was October before everything was completed and out of my hands.

Part II of the *Eighth Annual Report* reached me on Feb. 25, 1890. Since all the proofs had gone back and the plate corrections had been sent in a long list of *errata* had been found. I drew them up, but never asked that they be printed. I have always kept a typewritten set in my office copy, and it is still there. My reprints arrived on March 25, 1890. I distributed them as usual, sending the foreign ones through the Smithsonian International Exchange Office. The paper was so purely bibliographical that it did not attract much attention. I received a few complimentary letters, only one of which deserves to be reproduced. It is as follows:

"MANCHESTER, July 14th, 1890

"MY DEAR SIR:

"Many thanks for the extraordinary evidence of your industry which I received a few days ago. How in the world you mustered courage to attack so gigantic a piece of work, I cannot imagine. It seems to me to have demanded *all* the reading of a long lifetime, as well as the power of reading in a

score of languages to have brought about such a result. It only demonstrates to me how differently men's minds are constituted, and for what very different kinds of labour they are adapted. So far as quiet research amongst *natural objects* is concerned, I am never appalled, and never tired; but the idea of such an onslaught *upon books* would send me into convulsions! But you are undaunted and undauntable. So go on and prosper until you achieve your daring design. [The remainder of the letter describes the work upon which he was then engaged.]

"Ever truly yours,

"W. C. WILLIAMSON."

Ibid., Part II, Washington, 1889, pp. 663-960, pl. lxi.

May, 1890—Ætat. 48.

264. Notice of Memoir. On Fossil Plants collected by Mr. A. R. McConnell on Mackenzie River, and by Mr. T. C. Weston on Bow River; by Sir William Dawson. Trans. Roy. Soc. Canada, Vol. VII, Sect. IV, 1889

History.—Written Feb. 6, 1890.

The American Journal of Science, New Haven, Conn., Third Series, Vol. XXXIX [Whole Number LXXXIX], No. 233, May, 1890, p. 406.

May 2, 1890—Ætat. 48.

265. The Course of Biologic Evolution*

History.—Written Sept. 30, 1889, to Jan. 12, 1890. Delivered as presidential address of the Biological Society of Washington, Jan. 25, 1890. In this address I set forth a large number of principles, some wholly new, and all important. It contains the first statement of the principle of sympodial development. That of fortuitous variation was also treated in a general way. It constituted one of my most important contributions to science.

Proceedings of the Biological Society of Washington, Washington, D. C., Vol. V, 1890, pp. 23-55; Reprint, pp. 1-33.

THAT organic forms are the product of evolution is now not only generally accepted by educated people, but is also fairly well understood as a general proposition. But the special nature of the evolutionary process, particularly the *modus operandi* of the laws of development, is only vaguely or crudely comprehended by any but specialists in some branch of biology, and is not clearly understood by all of these. In proof of this I recall a lecture by Henry Ward Beecher, delivered in this city within a year of his death, in which he attempted to expound the modern scientific doctrine of evolution, but in which he showed that he had no adequate idea of what is meant by the arborescent, much less by the dichotomous character of the process of organic development, and seemed to suppose that the progress from monad to man had been one continuous ascending series. He mentioned, for example, as among the ancestors of man, a number of animals belonging to the Ungulata, Carniv-

* Annual Presidential Address delivered at the Tenth Anniversary Meeting of the Biological Society, January 25, 1890, in the law lecture-room of the Columbian University.

ora, etc., which are known to be entirely off the anthropogenetic line.

Such crude exposition of so important a law as that of evolution can only react against the progress of its acceptance as a scientific truth, and there seems to be great need that the exact nature of this law be worked out, and that all attempts to popularize it be correct and be accompanied by the necessary qualifications and an explanation of important subordinate laws. Only thus can the coarse and repugnant conceptions which seem to be taking possession of the popular mind be removed.

EXTINCTION OF TRUNK LINES OF DESCENT.

It is especially important that the first great qualifying principle, which I propose to call *the law of the extinction of trunk lines of descent*, be made clear, since it lops off at one stroke, the most serious of all popular misconceptions. I shall assume that the principle of genealogic dichotomy is clear to the minds of all, since it is nothing more than the simple law of toconomic descent as exemplified in every human genealogy and every family register applied to all life, except that it relates to species instead of individuals.

Sympodial Dichotomy.—But while organic phylogeny is, in a certain sense, arborescent and dichotomous it cannot be directly compared to any ordinary tree nor even to a plant that branches in a strictly forking or dichotomous manner, such as an *Anychia*, for example. It resembles more nearly that form of indeterminate growth which is termed *sympodial*, in which, instead of the two forks being equal and divergent, one of them has to be regarded as the main trunk and the other as a branch, but in which the branch possesses the greater vigor and vitality and virtually becomes the main trunk, the true stem dwindling, and either dying out entirely or continuing as a reduced and degenerate form. There are many plants, such as the common grape-vine, the houseleek, the heliotrope, and the forget-me-not, that exhibit this sympodial dichotomy.

Types of Structure.—In studying the operation of this law in biology a number of important facts are to be noted. It is first necessary to consider what may be called *types of structure*. These, in our illustration of sympodial dichotomy, represent first, the main trunk, and afterward the successive branches which become virtually the main trunk. Except in parasitism and other anomalous cases, the development along the main trunk is in the nature of an ascending series of forms, in the sense that the structure grows more and more perfect. There is a differentiation of organs and functions and an integration of parts into organisms of higher and higher capacity, but all are constructed upon the same general plan and represent a

single and uniform type. This process of perfectionment in the organisms of original type constituting the main trunk proceeds as far as the nature of that type of structure will permit. The branch which is to constitute the new and higher type is ultimately developed out of this original trunk, but there is no fixed time for its appearance. The original type may have reached its maximum development and remained stationary for any length of time, or it may have already begun to decline before this takes place. In fact it may never take place, but such organisms perish and leave us no history. The branch must possess a higher type of structure, otherwise it must dwindle and also disappear. To give it fresh vigor and power to continue the stock it must have acquired, through the known laws of variation and selection, some advantageous character not possessed by the original type, to which its superior vigor is due. It then in turn continues to develop and goes on improving in the same manner as the main trunk did before it, until, like that, it reaches the maximum limit to its capacity for progress, *i. e.*, until nothing more can come from that type of structure. Like its ancestor, too, it then remains stationary for an indefinite period and eventually declines, and either persists in a degenerate form or dies out altogether. A second branch endowed with still higher capacities is developed from the first and this repeats the process, and so on indefinitely, higher and higher types being successively developed, carrying up the system by this process of ascending sympodial dichotomy.

Persistence of unspecialized Types.—It often happens that the highest organisms of the more ancient types become extinct while the lower or less perfect ones persist and are found mingled with organisms of the higher types that are the dominant forms of life at subsequent epochs. This fact has led those who did not understand the law of types, as just stated, into doubts relative to the fact of development, since the certainty that organisms belonging to types that still exist, but of much higher rank, formerly inhabited the globe gave rise to the belief that there has been degeneracy instead of progress. To escape this error it is necessary to understand that progress takes place primarily through the development of new and higher types of structure, embodying successively higher and higher capacity for improvement, and that the archaic forms belonging to lower types, and therefore, as it were, upon a lower plane of life, unable to compete with those of higher type, are repressed and only appear among the latter as humble, and, as regards their own ancestors, really degenerate forms.

We thus have a series of epochs in the earth's history during each of which a different type has predominated, each later type being higher in its capacity for improvement than its predecessor. You are all more or less familiar with the successive

reigns of articulates in the Cambrian, mollusks in the Silurian, fishes in the Devonian, reptiles in the Mesozoic, and mammals in the Cenozoic; and you have doubtless frequently heard astonishment expressed at the great perfection to which the articulated type attained in the Trilobite, the molluscan type in the Ammonite, the piscine type in the Ganoid, the reptilian type in the Dinosaur, and the mammalian type in the mastodon, the highest expressions of all of which belong to geologic periods, and whose living representatives, with few exceptions, belong to the humbler forms of life.

DEVELOPMENT IN PLANTS.

As a specialist only in the lower of the two great kingdoms it is not my place to enter into details respecting the working of these several laws in the animal kingdom, even if I were competent to do so. My illustrations must therefore be chiefly drawn from plants.

It is well known that the three principal groups of modern cryptogams, the ferns, Lycopodiaceæ, and Equisetaceæ, represent the degenerate descendants of a vegetation which formed extensive forests in Carboniferous time, and Hugh Miller, Dr. Lindley, and some more recent authors have used this fact in the manner above referred to, as demonstrating that the life-series of the globe is as likely to be a descending as an ascending one, and that development as a general principle is not proved. Of course it is now well understood that natural selection does not necessarily produce an ascending series, as for example, in parasitic degeneration. But the principle which I have formulated to-night of type degeneracy has been almost entirely ignored, although it is alone able to explain the most important facts that seem opposed to evolution in general. The modern degenerate cryptogamic vegetation is one of those facts and to it I must devote a few moments of explanation.

The so-called natural system of classification in botany is based primarily upon the reproductive function. As founded by Jussieu it was exclusively so based, but de Candolle undertook to introduce a new principle, viz., that of the structure of the axis or trunk, by which he separated exogenous from endogenous plants, and supposed that this line could be drawn between monocotyledons and dicotyledons, erroneously including the gymnosperms in the latter of these groups. The weight of his authority not only long retarded the discovery of the true position of the gymnosperms as the immediate descendants of the cryptogams, but it had the further effect of barring out the important truth which vegetable paleontology has at last made clear that there once existed a large class of exogenous cryptogams.

Origin of Exogeny.—It has long been known that the Stig-

mariaes of the coal measures possessed an exogenous structure, and as early as 1839 Brongniart discovered that the stems of *Sigillaria elegans* consisted of a medullary center surrounded by a thin exogenous zone within a thick cortex. The woody zone was shown to be composed of distinct wedges separated by medullary rays. It is now known that nearly or quite all coal plants having the external characters of *Sigillaria* have this exogenous zone. It was also early discovered that certain coal plants with the general appearance of *Calamites* exhibit an exogenous structure, and it was at first supposed that these must be something very different, and they were accordingly called *Calamodendron*. Professor Williamson has shown that all true *Calamites* have an exogenous structure of a very definite character. He has also proved that the distinction drawn between *Sigillaria* and *Lepidodendron* based on this character is not tenable, since some true *Lepidodendra* also show the woody zone and medullary rays.

When Brongniart had made the discovery referred to he changed his mind with regard to the plants of the coal measures, and ever afterward maintained that *Sigillaria* and *Calamodendron* must be phanerogams, referring them to the Coniferæ. This complete reversal of his former logical and correct views was due to the preconceived opinion that exogenous growth was necessarily correlated with coniferous and dicotyledonous plants, as taught by de Candolle, and there is still a French school of vegetable paleontologists, who, as disciples of Brongniart, continue to maintain that *Sigillaria* must be placed in an entirely different class from *Lepidodendron*, and *Calamodendron* from *Calamites*, and who are disposed to deny the cryptogamic character of all forms possessing an exogenous structure.

Now the truth seems to be that in the process of development in plants the exogenous structure has been attained in varying degrees along several ascending lines, and that there is a different kind of exogeny in the calamite, the lepidophyte, the cycad, the conifer, and the dicotyledon, while something resembling exogeny has been shown to occur in certain fossil ferns and in certain living monocotyledons. Exogenous cryptogams probably no longer exist. The reign of the cryptogam has come to an end. It occurred in remote Carboniferous times when these plants constituted the greater part of the earth's vegetation. It was then that certain types of the Lycopodiaceæ and Equisetaceæ became forest trees and were supported by exogenous trunks. These types have long since disappeared according to the law of the extinction of trunk lines of descent, and it is only the earlier and simpler types that have come down to us according to the law of the persistence of unspecialized types. The flicine, equisetian, and lycopodian types continued to develop until they reached the highest state attainable by

plants having that structure. They even acquired the exogenous character; but only in a rudimentary form.

It would be wholly misleading to place the exogeny of these plants on a par with that of the modern exogen. In the pine and the oak, as every one knows, the bulk of the trunk consists of what we call *wood*, that is, of concentric layers of thick-walled vascular cells, giving to the trunk great strength and resistance, and although in the great sequoias and in the cork-oak the cortical portion, or bark, may attain a thickness of over a foot, still this is a relatively small portion of the entire trunk, and contributes comparatively little to its support. Now, if we imagine a tree in which the bark constitutes the bulk of the trunk and the wood only a comparatively narrow zone close to the central pith, we shall have some idea of the exogenous cryptogamic forest tree of the Carboniferous age. Something approaching it can be seen on a small scale in the first year's growth of a modern exogen, and in most herbaceous plants of that type, and we have another approach to it in the trunks of living cycads.

But when we speak of such thick bark it must not be supposed that we mean the dry corky and flaky exterior which is popularly called bark. This, in the modern exogen, constitutes the greater part of the bark of old trees, but is really the cast-off and, to a greater or less extent, dead matter pushed outward by the annual growth of the bast and liber, or the true live bark of the tree. For every exogen is also an endogen outside of the cambium layer. The bark grows by the deposition of new matter to its interior. It was even so with the exogenous cryptogam, only the endogenous or cortical portion, *i. e.*, the bark, then constituted the greater part of the trunk, whereas it now forms only a thin zone at the periphery.

This difference of degree is so great that it practically amounts to a difference of type, and far back in early Carboniferous time the new type had begun to appear, seemingly along two independent lines, the one typified by the form called *Noeggerathia* and leading to the modern *Cycadaceæ*, the other by the form called *Cordaite*s leading to the modern *Coniferæ*, which two great families rivaled each other for the mastery of the vegetable world during Mesozoic times.

Origin of Phanogamy—Gymnospermy.—It is, however, doubtful whether this great advance in the direction of strength and stability of trunk would have alone sufficed to give these new types the victory in the struggle with the tree-ferns, calamites, and lepidophytes of that epoch. Correlated with it was a still greater advance in the structure of their reproductive organs. The highest types of modern cryptogams only occupy the stage called *heterospor*y, *i. e.*, the possession of two kinds of spores, the microspore, or male, and the macrospore, or female spore. That stage was reached by all the higher types of Carboniferous

cryptogams. But by a series of steps, which recent researches have enabled us to trace in living forms, the passage was made in that early day from heterosporous cryptogamy to true gymnospermy, and the barrier was crossed which separates the cryptogam from the phanerogam. The origin of true flowers, albeit they were minute, inconspicuous, and devoid of color, fragrance, or beauty, took place at that ancient date. They were some such flowers as our sago-palms and our pines and cedars have to-day. Many fruits have been preserved for us in the coal measures and some of them closely resemble those of the ginkgo or maiden-hair tree. There are other strong proofs that the earliest Coniferæ belonged to the yew tribe of the ginkgo type, a type which is now nearly extinct, having but this single living representative. It was this type, and not the true pines and firs, that represented the conifers during the Jurassic period when the cycadean vegetation predominated over all other forms. And yet this solitary survivor of that long line of ancestors, this waning, tottering, dying ginkgo, with its perfect nut and ample deciduous foliage, may be properly regarded as the highest type of conifers, while the pines, spruces, and junipers must be looked upon as somewhat lower types, persisting according to the law already explained.

Angiospermy.—The next great step was from gymnospermy to angiospermy, the beginnings of which are buried in obscurity. In the gymnosperm the tender developing ovule and maturing seed is exposed to every rude element that besets the life of a plant. Thus exposed it is impossible for it to attain that delicacy of organization necessary to the highest perfection of vegetable growth. Protection of the germ thus early became the great desideratum. When it was first attained we know not, but there are some uncertain indications that angiospermous plants existed in Carboniferous time. But if so they did not belong to the higher or exogenous types. The struggles for the protection of the trunk on the one hand, and for the protection of the germ on the other, were independent struggles. Progress toward exogeny had nothing to do with progress toward angiospermy, and if the latter was attained during Carboniferous or early Mesozoic time it was attained only by endogenous plants, and the earliest angiosperms were endogens and not exogens. That is, the lower type from the standpoint of internal structure became the higher type from the standpoint of floral structure. Progress could therefore only be slow. What was gained by the one was lost by the other. Not until both these steps should be taken by the same type of plants could any new departure take place, and the history of plants shows that it was not until this combination occurred that the great revolution in the vegetable world was brought about.

Exogenous Angiospermy.—The time came at last, we know

not at what precise period, when exogenous plants acquired a closed ovary. This is the highest type of vegetation yet reached, and the proofs of its potency confront us every time we behold a modern forest of dicotyledonous trees. The great variety, beauty, strength, and grandeur of this now dominant vegetation amply attest the efficacy of exogeny combined with angiospermy in the attainment of vegetal perfection. Yet the time that elapsed from the beginning of either of these advances, taken alone, to that at which their fortunate combination took place was enormous. Not in the great coal period nor its closing Permian stage; not in the Trias which succeeded did there come forth a single exogenous plant whose germ was thus protected. The great and abundant fossil floras of the Rhetic and Lias of India, Australia, Bavaria, Sweden, and their near equivalents in Virginia and North Carolina, the Connecticut valley, and in both Old and New Mexico, have none of them yielded a trace of any such plant. The same is true of the equally abundant Oolitic floras of Yorkshire, France, Italy, Siberia, and Japan. Not even the highest Jurassic strata of any part of the world have with certainty produced an exogenous angiosperm. The oldest formation at which such plants occur is that on which our own city, the nation's capital, stands, viz., the Potomac formation, whose geological position is doubtful as yet, but if Jurassic, certainly represents the extreme uppermost part of that system. By the author of its flora, Professor Fontaine, it is regarded as the equivalent of the Wealden, which is now commonly supposed to be the fresh water equivalent of the Neocomian or lowest member of the Cretaceous. So late did this now overshadowing type of plant life appear upon the globe. The rapidity with which it advanced, conquering and supplanting all rivals, may be better understood when we remember that it forms eighty-five per cent. of the flora of the Dakota group, which corresponds to the Middle Cretaceous.

A new and vigorous type of vegetation had been developed, the genealogical vine had put forth a fresh branch, the plant world had acquired a new lease of life, and it seems to us, looking back over its history, to have actually taken a leap forward at about this epoch, and ever after to have marched on with enormous strides.

Development of Floral Envelopes.—The resources of improvement in organization were, however, not yet exhausted. The germ was, indeed, now protected, and might acquire within its safe chamber all the subtle shades of perfection possible, but the delicate floral organs by which the fecundation of this germ was accomplished were still exposed, as indeed, it would seem, to a greater or less extent, they must always be. Yet means of their better protection were possible and were gradually adopted.

Apetal.—The very earliest flowers were probably destitute

of any protecting envelopes (achlamydeous), and some such still exist, but most of the lowest types of dicotyledonous plants are provided with one floral envelope, sometimes reduced to a few mere scales, sometimes with several distinct sepals in a whorl around the essential organs, sometimes with these united at the base, and occasionally with a bell-shaped, funnel-shaped, or even tubular calyx. Such plants are called apetalous or monochlamydeous. Paleontology shows that those forms which are now apetalous, especially those in which the flowers are borne in catkins, or are nearly altogether naked, prevailed in early times over those provided with two sets of floral envelopes, which is far from being the case at present. Our law, too, is here again exemplified in the great perfection attained in those early times by such apetalous trees as the poplar, the plane-tree, the fig-tree, the laurel and the sassafras.

Polypetaly.—The next step was the development of a second floral envelope, which, however, had its beginnings in small, strap-shaped, or even bristle-shaped petals. In our current botanies as prepared by Gray, de Candolle, and Bentham and Hooker, the plants having separate petals, or polypetalous plants, such as the rose, buttercup, mallow, etc., are placed before those having the corolla all in one piece, like the morning-glory, honeysuckle, etc. This position is given them to indicate that the authors of these books regarded them as of higher rank. But the geological history of plants teaches that such, at least, was not the order of nature in their development. It shows that polypetalous plants were very early developed. We find them at the earliest epoch at which dicotyledons begin to appear in any great abundance. It is true that we rarely find the flowers, and cannot say with certainty that they were the same as they are to-day. It is quite possible that trees of Cretaceous time whose leaves resemble those of modern polypetalous genera may have then had wholly apetalous flowers, but this is as yet mere speculation.

In this group we have another fine illustration of the law which I have stated, according to which the highest attainable development of any given type of structure is early and rapidly acquired. We are in the habit of regarding our magnolias, our tulip-trees, and the Australian eucalypts, as among the finest specimens of polypetalous plants, and yet the genera *Magnolia*, *Liriodendron*, and *Eucalyptus* appear and are rather prominent in the Middle Cretaceous floras of Europe, Greenland, and America. There was some doubt until recently whether the *Eucalyptus* really was an American type, so remote is its present home. But during the past summer a member of this Society, Mr. David White, has conclusively demonstrated that these trees flourished in abundance on what is now Martha's Vineyard during the Cretaceous age. They probably extended over the

entire western world in that vast antiquity before the human race had made its appearance on our planet.

Gamopetaly.—There was one other step to be taken, the step from the polypetalous to the gamopetalous flower, from a corolla consisting of numerous distinct petals forming a whorl around the stamens and pistil within the calyx, to a corolla consisting of a single piece in the form of a bell, a funnel, or a tube, more and more completely protecting the essential organs. The older botanics call such plants, *monopetalous*, emphasizing the fact that the corolla is of one piece, but wholly ignoring the process by which it became so. In fact, by placing this group after the polypetalous one they suggest that they are lower in rank and that monopetalous plants may have become polypetalous by division of the corolla into numerous petals. The German investigators, however, have shown by embryological study that the movement has been in the other direction, the petals of polypetalous plants, having, as it were, united into a corolla, and this is confirmed by paleobotany in showing that polypetalous plants antedated monopetalous ones in the history of plant development. The later botanics, therefore, so far recognize this truth as to adopt the term *gamopetalous* to express this union or wedding of the petals.

The progress from polypetaly to gamopetaly had only begun when the geological record closed. Only a few gamopetalous fossil plants have been discovered. There is reason to believe that there were persimmons, whortleberries, olives, and arrow-woods, during Tertiary times, but most of these have small flowers, and in some of the living representatives the lobes of the corolla are cleft nearly to the base, suggesting that at an earlier period in their history they may have really been polypetalous. The more typical Gamopetalæ, with tubular or funnel-form corollas are for the most part unrepresented in the fossil state, and we must regard these plants as among the latest products of development in the vegetable kingdom.

Nature of Vegetal Development.—I have now endeavored to trace the progress of development in the vegetable kingdom from its earliest beginnings in cryptogamic life to its highest and latest expression in the gamopetalous dicotyledon, with a view especially to showing by what particular steps it has taken place, and how the two laws of the extinction of trunk lines of descent and the persistence of unspecialized types have combined to bring about the varied and abundant vegetation with which the earth is clothed. I have sought to emphasize the fact that this evolution has not been in a single ascending series, that the plants that have one after another succeeded to the mastery have each in turn attained the highest development possible to their respective types of structure and have then surrendered their sceptre forever to the new and more perfect

types evolved from them, and have usually dwindled down to comparative insignificance but persisted on in some of their lowest forms. I have wished to make clear and patent the important but rather recondite and popularly little understood truth that biologic progress takes place through this sympodial dichotomy, and not by true dichotomy, much less by the ordinary monopodial branching represented by the common figure of a tree. In other words the phylogenetic tree is something considerably different from the common genealogical tree. It further and especially differs in being exceedingly irregular in the intervals of branching. Expressing the process in time we observe that vast periods pass in waiting for the working out of the most simple principle, which, when once hit upon, produces a complete and rapid revolution in an entire department of life. I can liken it in this respect only to the progress of mankind as brought about by great mechanical inventions made at irregular intervals and producing undreamed-of revolutions in the whole industrial frame-work of society. The length of the stationary periods in biologic evolution is determined by no fixed law. When a type of structure has advanced as far as it is capable of developing it remains stationary as long as nothing interferes with its continuance. If no change should take place in its environment it might continue for an indefinite period. As, by hypothesis, it can advance no farther it can only vary in the direction of deterioration or extinction. The type of structure once fixed can never change. Only the degree of vigor, luxuriance, or abundance can undergo modification. Deterioration is everywhere illustrated by the present cryptogamic vegetation. The Carboniferous forests of *Lepidodendron* and *Calamites* are represented by our little club-mosses and scouring rushes, although they must have descended from trunk lines which had not yet acquired the exogenous structure. Extinction is exemplified by the absence of exogenous cryptogams in the living flora, as also of most of the later cycadean and coniferous types. There are several interesting cases of partial and rapidly approaching extinction. Among such may be mentioned the maiden-hair tree, the mammoth and redwood trees, and also, it would seem, the tulip and plane trees, all of which in their turn dominated the vegetable kingdom, but now, though undiminished in vigor or structural perfection, have been restricted in range, reduced in number, and nearly crowded out of existence.

We have seen that the deterioration or extinction can be only brought about by a change of environment. The only cause for the predominance of a type is its greater adaptation to the existing environment. If undisturbed any given type of structure will equilibrate in the direction of greater adaptation until this is no longer possible. But complete adaptation,

as I long ago pointed out,* is impossible. It is always possible for a new type to appear which shall respond more exactly to the surrounding conditions. The environment, it is true, may undergo unfavorable changes. The climate may change, or the type in its migrations may encounter unfriendly influences. Most effective of all is the ever-changing influence of the contemporary life with which a type must come into competition. It must, as we have seen, eventually encounter as a rival in the race for life, the new type which is to succeed it, endowed with elements of new life and with fresh powers both to overcome hostile influences and to utilize the resources of nature. Such superior types, as already shown, are ever and anon arising, proceeding from quarters least anticipated, appearing without regularity either as to place or time, springing sympodially from the original trunk, rising impiously above their parents, and ultimately overshadowing, repressing, crushing, and extinguishing the former lords of the vegetable kingdom. Such in brief is the generalized history of the rise and fall of empires in the world of plants.

What has thus far been said is perhaps sufficient to render clear to most minds the peculiar and complicated character of biologic evolution in general, and to show how widely it differs not only from the current crude popular conception of it, but also from the ideas which prevail among well informed and even scientific persons. I need not, I am sure, apologize in this age of specialists, for having confined myself almost exclusively to that kingdom of life with which I am most familiar. I believe that I can safely assume that the zoologists present, in whatever branch, have been able to parallel all the illustrations which I have given by similar ones in their own departments, leading to the same general conclusion.

EXTRA-NORMAL DEVELOPMENT.

Thus far I have only taken account of what may be called the normal or legitimate causes of such advantageous modifications of structure as have resulted in the successive upward steps which organic life has taken in the course of its history. But there is another class which may be called extra-normal, abnormal, or even illegitimate causes. Normal or legitimate causes are such as result in the production of characters which are of direct use to the organism. In extra-normal or illegitimate causes the characters produced are such as have only an indirect effect. Thus in the vegetable kingdom normal development tends chiefly in the direction of strengthening the stem, increasing the foliar surface, and protecting the germ and reproductive organs, *i. e.*, in the direction of strength, nutrition,

* American Naturalist, February, 1881, p. 89.

and reproduction, these being the three prime essentials, of existence. The various modes of strengthening the trunks and especially the attainment of complete exogeny, as seen in the trees of the present day, directly improved the conditions of existence and the chances for further development. The gradual attainment of broad appendicular expansions called leaves increased more and more the power to decompose the carbonic dioxide of the air which is the chief nourishment of plants. The separation of the sexes, the transition from spore-bearing to seed-bearing plants, the development of a closed ovary for the protection of the germ, and of floral envelopes for the protection of the stamens and pistils, all tended to perfect the reproductive function and render a higher type possible. These influences were therefore all normal and legitimate in acting directly upon the essential properties of the organism; and had no extra-normal or illegitimate influences come in to modify the results these direct ends would have been the only ones attained. Vegetation would doubtless have still been green as now, there would have been forests of large trees with strong solid trunks and umbrageous foliage; there would have been green grass and rushes, rank and luxuriant herbage, stately palms and graceful ferns, even as now, but this would have been all. Two of the leading features of the actual vegetation would have been wanting, viz., showy and fragrant flowers and highly colored, pleasantly flavored, and nutritious fruits.

A large, showy, or fragrant blossom is of no direct use to a plant. Indeed its nourishment is an expense to the normal growth of the plant. Still greater is the cost of the abundant nutritious matter in many fruits. In both these cases the value to the plant is indirect, and when we study the subject deeply we find that the cause of the development of such organs is a sort of teleological or final cause. Beautiful flowers and edible fruits are extra-normal or illegitimate products of nature, and those who fail to see this have but a crude and imperfect conception of the course of evolution.

Fortuitous Variation.—In a certain sense every influence that affects an organism is legitimate, and we have seen that the several great types have been brought into existence by the improvement of the special opportunities offered by the environment. We have also seen that these opportunities have presented themselves at long and irregular intervals, and, as it were, by chance. In this sense there is only a difference of degree between these normal and legitimate influences and those which I have called extra-normal or illegitimate. Their occurrence was fortuitous. They were the result of accidental variations in an advantageous direction seized upon by nature for the creation of higher types of life.

There is a school of evolutionists who maintain that this is

the only way in which progress takes place. This is held to be the strictly Darwinian view, as opposed to the Lamarckian view that the "appetencies," as Lamarck called them, *i. e.*, the individual efforts, strivings, and struggles of the organism in advantageous directions, aid in determining what the new and improved type shall be. In a paper which I had the honor to read before this society over a year ago on "Fortuitous Variation as illustrated by the genus *Eupatorium*"* I endeavored to show that this fortuitous variation was often successful even when no apparent advantage could result therefrom. The tendency to vary is in all directions, as from the center toward the surface of a sphere, and variation will take place in every direction which does not prove so disadvantageous as to render life impossible. In by far the greater number of cases the advantage or disadvantage is slight or imperceptible, and changes go on without improvement or deterioration, causing a great number of equally vigorous forms to arise, all differing more or less from one another. This accounts chiefly for the varied and manifold in nature, and but for this law, hitherto, so far as I am aware, unobserved, nature would be monotonous and uninteresting. From the esthetic point of view, therefore, this is the most important law of biology.

What is its importance from the scientific point of view? As you probably all know, there has been going on during several years past a very lively discussion of the principle of natural selection, and that principle has been vigorously attacked by a large and highly respectable class of working naturalists. Its vulnerable points have been fearlessly exposed and its defenders have been put to their wits' end to save it from serious impairment. It has seemed to me that their mode of defense was ill-chosen and that its weakness consisted in claiming too much for natural selection, more than it can justly be shown to accomplish. The weakest link in the chain is the first one, as Darwin himself admitted, and it seems strange that he, who maintained that the variations which natural selection seizes upon to the advantage of the organism are fortuitous, should not have conceived that these might go on as they began for a long time and result in important changes that were neither beneficial nor injurious. Those who question the principle of natural selection insist with apparent justice that the incipient changes due to accidental variation during a single generation are utterly inadequate to perpetuate and multiply themselves, that their utility must be infinitesimal and practically nil; and they pertinently ask how the machinery of natural selection was ever set in motion. Strange as it may seem, the defenders of natural selection have thus far found no better answer to this argument than to deny

* See abstract (all that was published) in *Nature* (London) for July 25, 1889 (Vol. XL, p. 310).

its force and to maintain that every variation, however slight, if in the direction of utility, begins to operate from its inception and goes on increasing with cumulative strength. This answer is not satisfactory and its inadequacy has been sufficiently proved. It should be abandoned and some other substituted, and until this is done natural selection will continue to lack a solid basis upon which to rest.

But it seems to me that there is an answer to the objection, and one which fully meets it. This answer is nothing more nor less than the patent fact already stated that fortuitous variation actually does go on at all times, in many directions, and to great lengths, without any perceptible change in the degree of adaptation which the varying forms have to their environment. I have shown how this takes place in one important genus of plants, and it would be easy to extend the observation to almost any other genus. I doubt not that the animal kingdom is also full of examples.

Here then we have the solution of by far the worst difficulty in the way of natural selection. The beneficial effect need not be assumed to begin at the initial stage. It need not be felt until well-formed varieties have been developed without regard to any advantage in the particular differences which they present. There seems to be no flaw in this mode of solving this paramount problem, and if it is objected that it amounts to a new explanation of the origin of species, I am ready to admit it, and I believe that more species are produced by fortuitous variation than by natural selection. Natural selection is not primarily the cause of the origin of *species*; its mission is far higher. It is the cause of the origin of *types of structure*, such as those whose history I have endeavored to trace, and through which alone biologic evolution takes place.

Extra-Normal Influences in the Vegetable Kingdom.—Returning from this important digression to the subject of extra-normal influences in the vegetable kingdom, let us inquire more closely into their exact nature. As already remarked, the most important are those which have resulted in the development of beauty and fragrance in flowers and of bright colors and agreeable flavors in fruits. But these are by no means all, and we must thus account for most burs, spines, thorns, and other forbidding features, viscid and glandular hairs, as in the sundew, and irregular and peculiar forms of leaves, especially such as are seen in the pitcher-plants, and a great variety of other structures not connected with the reproductive function.

What then are these supra-normal or illegitimate causes which result in such peculiar products? In the first place they consist in special changes in the environment which are seized upon to the advantage of the plant. Plants, in view of their stationary character, had especial need of two things, viz.,

cross-fertilization and dissemination. Growing together without power to change their position and mingle with remoter forms, there was perpetual danger that close interbreeding might deteriorate or destroy the stock. The seeds of such stationary organisms perpetually falling in the same spot tended to choke one another and to weaken and restrict the species. Every normal and legitimate means of averting these two dangers had been adopted by the earlier types of vegetation. The spores of cryptogams and the pollen of conifers were made so light that the winds would take them up and waft them to great distances. Certain grasses and other herbs were endowed with the peculiarity of being uprooted by the wind at the proper season and blown for miles over the plains, scattering their seeds. And even water had become and still remains a medium for the transportation of both pollen and seed from place to place and from shore to shore. But still these instrumentalities fell far short of the needs of the vegetable world in these directions. At last, and nearly at the same period in the earth's history, two new, and, one may almost say, unexpected agencies came forward, adapted respectively to the supply of these two prime necessities of the plant—viz., *insects and birds.*

Origin of Showy and Fragrant Flowers.—Away back in the dim darkness of the coal period when tree-ferns, calamites, and giant club-mosses, combined with archaetypal yews to people the steaming swamps of a hot, cloud-laden island world, there existed a strange form of insect which can only be compared to the cockroaches of our day, but which seems to have embodied in its structure the beginnings of all the varied types of insect life, the promise and prophecy not only of our dragonflies and beetles, but also of our flies, bees, and butterflies. And during the long ages that followed, while the plant life was passing through the history which I have briefly sketched, the insect world was experiencing a similar unfolding, and new and improved types, very much as in plants, were coming into existence, attaining their maximum development, and giving way to still higher ones, until some time in the late Jurassic or early Cretaceous age forms began to appear which were adapted to obtain sustenance from the pollen, and perhaps from the stigmas of flowers. To do this they were obliged to pass from flower to flower and would unavoidably carry the dust that adhered to their heads, wings and feet from one flower to others more or less remote. Cross-fertilization, that "secret of Nature" discovered by Sprengel, was thus effected, and new vigor was instilled into those forms which for any reason had been so fortunate as to attract these winged friends. We can figure to ourselves a rivalry springing up among plants as to which should offer them the greatest inducement, and through the action of natural selection, which here found a typical field for its normal opera-

tion, the entire nature of flowers underwent a rapid change. To continue the figurative expression, all flowers vied to excel in beauty and attractiveness; for these tiny insects possess esthetic tastes which do not materially differ from those of mankind.

To size, showiness, and beauty of coloration, was often added fragrance which was especially successful with moths and other nocturnal insects. Many special inducements were held out. Sweet and nutritious nectars were secreted from the petals to lure on the unsuspecting creatures, and deep, and peculiar grooves, sacs, and spurs were developed to hold this nectar in large quantities. These nectaries were so adjusted that no bee could enter without passing directly over the stigma and brushing upon it the precious dust of other flowers. Wonderful contrivances thus came into existence to secure this supreme end of plant being, and the present world of flowers was ultimately evolved.

The profound modification accomplished by this agency was not confined to size, color, fragrance, and the secretion of nectar. The forms of flowers underwent in many cases a complete change, and an infinite number of wonderful irregularities appeared, varying from the slightest differences in the petals to the amazing abnormalities of the orchids, all calculated to adapt plants to the useful ministrations of insects, sometimes, as in the yucca, to those of a single species of insect without which reproduction is impossible.

And thus it has come about that the form of every flower has its special meaning which can be interpreted by those who have penetrated this great secret. We hear of the language of flowers—that the rose signifies beauty, the daisy innocence, the violet modesty, the myrtle love—but science has discovered a new and real language which the flower not only speaks but writes in clear characters, and which the botanist deciphers and reads by much the same methods that the assyriologist employs when he deciphers and reads the arrow-head inscriptions upon the tablets of Nineveh.

It is thus that flowers are accounted for by modern science in all their beauty and variety. The old idea that they were made for man to admire and enjoy is exploded, and yet it remains true that they were made to be admired and enjoyed by creatures capable of admiration and esthetic pleasure. It is not true that any flower was ever "born to blush unseen" or "waste its fragrance on the desert air." There is a standard of taste so universal that what pleases the bee, the ant, and the butterfly, also pleases the senses of man. Biology has overthrown the anthropocentric theory as astronomy has the geocentric, and every creature lives in and for itself and shares with man to some degree the sublime attributes of mind and soul.*

* Here and later on I use the term *soul* in the sense of conscious desire strong enough to induce active effort for its satisfaction.

Origin of bright-colored and sweet-flavored fruits.—In seeking the origin of fruits we have to consider an almost parallel history of development to that which we have been studying in accounting for flowers. But here we must look to another kind of animal life, chiefly to the great family of birds. There were probably no bright-colored or sweet-flavored fruits until the close of Mesozoic time, because the future birds were as yet reptiles crawling over the ground or swimming in the waters, albeit some of them already possessed the inchoate attributes of their avian successors. Moreover, the vegetation of that early period was incapable of employing the intervention of winged life for its distribution. At first it consisted exclusively of spore-bearing plants whose dissemination was chiefly affected by the wind, and which depended upon the infinite multiplication of spores to make up for defective means of distribution. Later came on the gymnospermous types of cycadean and coniferous life, neither of which is now to any great extent adapted to the uses of the feathered world. Paleontology, both vegetable and animal, thus doubly confirms the view that fruits, in the sense here employed, had their origin simultaneously with the appearance of birds, as flowers did with that of flower-frequenting insects, toward the close of Mesozoic time. Attracted by their bright colors correlated with pleasant flavors, birds learned to visit the plants that bore such fruits. Flying thence to distant parts and voiding the hard seeds of berries and stones of drupes, they became the effective instruments for the dissemination of these forms.

The great problem of distribution was thus solved by bird life as was that of cross-fertilization by insect life, and just as plants vied with one another to attract insects to their flowers, so did they also vie with one another to attract birds to their fruits. Here again it was the universal esthetic faculty that enabled the ancient bird life to prepare the earth for human habitation, and yet, no more than in the previous case was man the final cause. So uniform is the standard of taste throughout the psychic world that what contributes to the pleasure of a bird or an insect also supplies some esthetic want in the race of men.

ABNORMALITIES OF SEX.

There is one other abnormal or supra-normal influence in the organic world which is so important and so well illustrates the principle now under consideration, that it seems proper briefly to advert to it. I refer to the causes which in many cases, particularly in the animal kingdom, make one sex differ so widely from the other.

An array of facts taken from asexual life and from the very early stages of sexuality converge to show that primarily and

normally the female is the main trunk line of development, while the male is merely accessory, and need have no importance apart from the reproductive function. Such restriction actually exists in a great many of the lower organisms and in some that are quite highly organized, while throughout the invertebrate world the physical superiority of the female is the rule and that of the male is almost unknown. Female superiority is also the rule and male superiority the exception among all vertebrates except birds and mammals, and sometimes occurs even in these. Normal or legitimate development would make it universal. But in most birds and mammals, the opposite state of things exists, viz., male superiority, and we are so much more familiar with these two highest types of life that the impression is almost universal that the male sex is in some way the primary and dominant one. I shall not waste your time in attempting to refute this popular impression. Those who defend it simply display their lack of acquaintance with the lower forms of life. My own attention was drawn to the subject by certain remarkable phenomena presented by plants, but a study of the very early stages of animal life is sufficient, with the least reflection, to set the whole question at rest.*

The problem is, therefore, to account for this apparently abrupt reversal of the normal process of development as it went on prior to the advent of birds and mammals. What was the extraneous and illegitimate agency which began to operate early in the development of avian and mammalian life? The one term which most nearly expresses it is *sexual selection*, proposed by Darwin. In my opinion the discovery of the principle of sexual selection has equal if not higher rank than that of natural selection, since its influence when fully understood will be found to be as great, and to Darwin alone is due the entire credit of making it known. Strangely enough Dr. Alfred Russel Wallace, who simultaneously and independently worked out the law of natural selection, is disposed, as shown by his recent work on Darwinism, to reject sexual selection altogether as a factor in biology; yet to my mind, it remains debatable which of these two great laws has exerted the more profound effects in modifying the course of organic development. It certainly cannot be said of natural selection that it has produced a complete revolution in that course, or has, so to speak, reversed the wheels of biologic progress, as sexual selection has done; not in the sense of producing a retrograde movement, but in that of shifting the axis of evolution, if I may be allowed the expression, from its normal position to a wholly abnormal one, and raising to a prime

* For a fuller, though popular, treatment of this subject, see the *Forum* for November, 1888, Vol. VI, p. 266.

factor what was originally a mere incident in the history of organic life.

Female Selection.—But by sexual selection Darwin meant only *female selection*, which would be the more accurate expression. It was not until the era of birds and mammals that the female really began to exercise a choice, or if, as is proved in a few cases, the females of lower creatures did exercise a choice, the result was the same as in the higher, the superiority of the males.

You all understand this law too well to make any explanation of its operation necessary, and I only desire to bring it forward as one of the most important of all the abnormal or illegitimate influences that have brought about the present state of things. I also wish to point out its analogy to the other two influences which I have considered. For here again, size, strength, and beauty, as displayed in the males of so many animals and birds, are the products of a dawning and growing esthetic sentiment, the expression of a developing taste, which is so nearly identical with the most highly developed tastes of mankind that there are no higher objects of human admiration than the gorgeous plumage of birds or the graceful forms of animals—than, for example, the feathers of the ostrich or the antlers of the stag.

Male Selection.—The reign of female selection has been a long one, and throughout the two classes of animals in which it is chiefly displayed it still prevails in full force. It is probably still the dominant influence in the human race, even among its highest types, though here resulting more in mental than in physical superiority in men.

But there are signs that this may not always remain so. I long ago pointed out* that among the higher races of men a form of *male selection* has already begun to exert a strong influence. In civilized life the choosing is not left wholly to women, and with the progress of culture and refinement this mutuality of selection grows more and more marked. That male selection will prove equally effective with female selection is already proved by the ever increasing beauty of women under its influence; and those who think men perverse because they prefer beauty to all other qualities, or women trivial because they make their personal appearance a leading aim of life, have never learned the great law of nature which overrules all the trite maxims of the purists, that beauty means worth—perfection—and that beautiful companions insure perfect offspring, an improved posterity, and a better and nobler race, of men as well as women. And this is why the love of and preference for the beautiful has a higher and a deeper sanction in the everlasting order of things than can be given by any church, any court of law, or any code of morals.

* *Dynamic Sociology*, 1883, Vol. I, p. 613.

THE PSYCHIC ELEMENT.

In all the cases considered of what I have denominated extra-normal or illegitimate influences affecting the course of biologic evolution, there is revealed to the careful student a common principle to which their peculiar character is due; a certain element of power and independence which gives to them both their anomalous and erratic character among organic laws, and also their remarkable efficacy and success in accomplishing the ends of evolution itself. What is this common principle, this element of power? It is expressed in the single word *psychic*—I had almost said, in the one word *mind*. Philosophers correctly identify these conceptions, and anything that transcends the purely vital partakes of the attributes of mind. This new force, manifesting itself in at least three prominent ways at almost the same time in the earth's history, and producing such astonishing revolutions, was the psychic force beginning to respond to a long process of cephalization, or brain-enlargement, in the animal world. It represents the birth of the soul in nature; it was the response to a demand for the satisfaction of wants, of instincts, of tastes; it was the first expression of purpose and of will. For these are the attributes which led the bee to seek the nectar from the flower, the bird to visit the brilliant cluster of fruit, or the female of the higher creatures to choose the most beautiful male for its mate. And these are psychic qualities and represent the subjective half of the world of mind—the great heart of nature.

The strictly biologic record properly closes here. To show that this same force continues to produce its unlooked-for effects at a higher stage of development, operating from the objective side, through the intellect, or head of nature, and that the results have here been as much more surprising and far-reaching as the organisms through which they were accomplished were higher in the scale of development,* though an easy task, would not only carry me too far, but would trench upon the domain of anthropology and belong more properly to a sister society.

Cosmic Epochs.—Taking a retrospective view of the entire field of evolution and bearing in mind its uneven course as I have sought to depict it, there may be discerned, standing out prominently above all the minor fluctuations, a few great cosmic crises or epochs, in which the change appears so abrupt and so enormous as to suggest actual discontinuity. Three such cosmic epochs belong to the history of life on the globe. The first was the origin of life itself. The second was the origin of soul or will in nature. The third was the origin of thought or pure intellect. While I do not say that any of the factors

* This is the "indirect method of conation." See *Dynamic Sociology*, Vol. II, p. 99.

producing these epochs came suddenly into existence, or that any definite lines exist separating life from soul or soul from intellect, theoretically speaking, the general fact remains that they are practically distinct principles, having diverse effects, originating at widely different periods in the earth's history, and succeeding one another in the order named. Of these three great principles, life, soul, and intellect, and of the cosmic epochs which they have produced, I have in the closing part of this address, attempted to consider the second only, and I have chosen it chiefly because its bearing upon evolution appears to have been wholly ignored or misunderstood. Soul or will is simply desire in the act of seeking satisfaction, and I once presented the evidence to show that this is a true natural force,* obeying all of the three Newtonian laws of motion; but its effects, compared with the other forces of cosmic and organic evolution, appear to us erratic or even spasmodic. Nevertheless its potency is far greater and the ends attained through it are upon the whole the same. It owes this character to the fact that it is a psychic force as distinguished from either physical or vital forces. Its study is therefore a part of psychology, and from it we should learn that psychology is simply a branch of biology and its study should begin with animals and not with man. Finally, the peculiar character of this psychic influence is due to its being a product of higher organization. Mind is to biology what protoplasm is to chemistry. Psychology is transcendental biology.†

* *Dynamic Sociology*, vol. II, p. 95.

† So called by Auguste Comte, who refused to recognize it as a distinct science. See his *Philosophie Positive*, vol. IV, p. 342.

May 27, 1890—Ætat. 48.

266. [Flora of the Laramie Group]

History.—Remarks on the paper of Dr. J. S. Newberry on *The Laramie Group*, read Dec. 26, 1889, at the meeting of the Geological Society of America in New York. They were made without notes or manuscript. The stenographic report of them was received on Feb. 4, 1890, and corrected, and the footnote was then appended.

Bulletin of the Geological Society of America, New York, 1890, Vol. I, pp. 529-532.

May 27, 1890—Ætat. 48.

267. [Cretaceous Flora of Gay Head]

History.—Remarks on the paper of Mr. David White on *Cretaceous Plants from Martha's Vineyard*, read Dec. 28, 1889, at the meeting of the Geological Society of America in New York. They were dictated to the graphophone from memory and from notes Feb. 13, 1890.

Ibid., pp. 555-556.

MY principal object in coming to this meeting was to listen to this paper, as I was associated with Mr. White in his work and am deeply interested in it.

I desire merely to emphasize the great importance of the results at which he has arrived. Not until the past season has anything definite been known of the fossil flora of *Martha's Vineyard*, the few fragments figured by Hitchcock not having been determinable and having no geognostic value. As Mr. White has

remarked, the ablest geologists in the country have long been at work upon the question of the age of the Gay Head beds, and, as shown by the older as well as by recent papers, especially those of Professor Shaler, great differences of opinion and doubt as to their age have prevailed.

The discovery by Mr. White of undoubted Cretaceous fossil plants has settled that question so far as the particular strata from which these plants were found are concerned. In all his recent papers, including the one read before the Society on Thursday last (pp. 443-452), Professor Shaler has insisted that all except the very base of the Gay Head section is Tertiary and even Miocene or Pliocene.

I do not pretend that the entire section at Gay Head and Nashaquitsa cliff is necessarily Cretaceous. The plants were found in the Gay Head section near the middle, and it is very possible that, considering the extent of the beds and the length of the section, the overlying strata may be Tertiary, even Miocene. But if there is a great thickness lying above these beds, so there is a great thickness lying beneath them, and therefore the section must extend far down into the Cretaceous. It would seem then that Mr. White's investigations during one short season have done more to settle the age of these beds than all that has been done before.

I gladly testify to the indefatigable zeal with which Mr. White pursued his investigations against the greatest difficulties and discouragements. It required much careful thought and labor to ascertain in what particular manner the plants were preserved; but after this had been fully settled he was very successful in finding them, although they were not abundant; and he persisted until his collection amounted to five barrels of very excellent material, which is being elaborated at the National Museum.

May 29, 1890—Ætat. 48.

268. Genius and Woman's Intuition

History.—Written March 1, to April 19, 1890. On Feb. 13, 1890, Mr. Metcalf wrote me as follows: "Grant Allen, you remember, volunteered a reply to your *Better Halves*, all the way from Italy. Now here he is [again], drawn out in a line exceedingly agreeable to his taste, and very open to attack. Do you not want to reply in turn?" Enclosed was the proof of the article by Grant Allen which appeared in the *Forum* for May, 1889. I agreed to write the article and proceeded to do so. I called it *Intuition vs. Information*, but Mr. Metcalf on May 13, suggested and I accepted the title that it bears. I had already answered Grant Allen's first article in reply to *Our Better Halves* (see *supra*, p. 130). It is curious that in *Pure Sociology* (p.298) I referred to that but not to this article of his.

I received a letter from Mary A. Dodge (Gail Hamilton) dated June 1, 1890, expressing her great pleasure in reading this article, and characterizing Grant Allen's notions as "inanities." She was at the time living with Mrs. James G. Blaine, who, she said, had also read it and spoke approvingly of it.

Public Opinion used about half of this article, quite skillfully condensing it without seriously disturbing the argument.

I may say incidentally, in connection with this article, that, having at the time a graphophone at my house and another at my office, and being in the habit of dictating official letters and scientific (paleobotanical) manuscripts and taking the cylinders over to be typewritten, I undertook to dictate the article to the graphophone. But when it was written out I found it much too verbose. I had used too many words, and I was obliged to rewrite it entirely. No such difficulty attended my correspon-

dence or the preparation of my official reports and memoirs, and I continued to dictate these as long as I was on the staff of the Survey. But I never again attempted to dictate a philosophical article. It is the necessity for thinking as I write that makes the difference. My pen is a check to my brain. I suppose I could have overcome this by practice.

The Forum, New York, Vol. IX, No. 4, June, 1890, pp. 401-408; Public Opinion, Washington and New York, Vol. IX, No. 9, [Whole No. 217], June 7, 1890, p. 201.

THE article in the Forum* on "Woman's Intuition," by Mr. Grant Allen, attracted me strongly by its title, as I expected to find in it a fresh presentation of this much-discussed subject from the point of view of modern biology and psychology. Almost every writer of any discursiveness whatever has had his say about the idiosyncrasies of the female mind, and how it differs from the male mind; its instantaneous and sometimes surprisingly accurate judgments being usually dwelt upon as the chief distinction. The only possible source from which anything new can be brought to the discussion is modern developmental biology. The reader had a right to expect that Mr. Grant Allen would draw the materials for his discussion chiefly from that source, but in this he is disappointed. Mr. Allen does indeed attempt to do this, and talks somewhat learnedly about natural selection, etc., but he fails to make the proper application of scientific principles to woman's intuition. He says that it is "a variety of instinct," and that it may be regarded as "a survival, affecting chiefly a single sex, though extending its outlying modes to a portion of the other"; but in so far as this is true it is nothing new.

The thing really to be noted about woman's intuition from the modern biological standpoint, is that it is a highly-specialized development of a faculty of the mind which originally had as its sole purpose the protection of the mother and offspring. It is a part of the maternal instinct, and, like all instincts, its acuteness and subtlety are proportioned to the narrowness of its purpose. The wonderful shrewdness which we observe in some animals, such as the fox, is due to the super-development of the knowing faculty in a single definite direction for a single definite purpose. The wants of animals are narrowed down chiefly to two general objects—food and protection; and nature can afford to expend a large amount of energy in sharpening the faculties that are expressly adapted to secure these ends. When we rise above mere instincts, we find that this super-development takes the

* May, 1889.

form of cunning, which is often so great as to cause astonishment. It is simply the concentration of psychic power, through the operation of heredity and natural selection, upon a single object, so that the totality of that power shall work toward the one most practical of all ends. The faculty which we are here considering scarcely differs from the rest of this class.

The power in woman of instantaneous and accurate judgment as to what to do when her safety or that of her children is in jeopardy, was developed during the early history of the human race, as it emerged from the animal into the properly human state; its only use was to protect the mother and the young from such dangers as beset them—dangers which increased with the growth of the intellectual faculty and the dispersion of the race over the globe. And with the origin and progress of civilization this power has increased in complexity, and has ever been the safeguard of the family against all attacks, strifes, and abuses, from whatever quarter. In the highest stages of enlightenment it still comes daily and hourly into use in guarding the virtue of woman, detecting the infidelity of man, protecting the youth of both sexes from temptations and pitfalls of every kind, evading the wrongs of unjust husbands and cruel fathers, checking dangerous financial extravagance or undue liberality in men, and in a thousand other ways. Upon such questions the judgments of women seem to be already formed in the mind, inherited as organized experiences of an indefinite past; and when an occasion arises they come forth instantaneously, without reflection and without deliberation. The dangers that have threatened woman and her helpless charges throughout all her history, have usually left her no time for these slower mental operations. She must act at once or all is lost; and natural selection has preserved those who could thus act, so that in modern society it is still true, and in a far wider sense than Addison supposed, that

“The woman that deliberates is lost.”

Such is the sphere—not an especially narrow, but yet a definitely-circumscribed one—of woman’s intuition, the female instinct of self and race preservation. But it must be remembered that every instinct is developed in harmony with the particular environment of the creature, and that outside of that environment it is useless. The quality of being “unerring,” never fully attained, is lost the moment the possessor of an instinct is removed to a different environment from that in contact with which the instinct was developed. It is so with this adjunct of the maternal instinct which we call woman’s intuition. It has value and real existence only within the sphere of its normal activity as above defined. Outside of this sphere, the judgments of woman are no more “unerring” than those of man, and to be equally

accurate and reliable, they require the same data and the same reasoning processes as do the conclusions at which men arrive upon the affairs of life.

The above constitutes an explanation of woman's intuition in the scientific sense of the word, and it seems strange that our author should have so completely failed to understand it. That he does so fail is evident from his almost reverential attitude toward the subject of his article. He seems to regard it as something mysterious and occult, even supernatural, unfathomable by human reason, and quite beyond the reach of all known laws of cause and effect—a sort of odic force, at which we must content ourselves to gaze and mutely marvel. Regarding woman's intuition as a sort of supernatural ken, he of course sees no reason why it may not be exercised in one direction as well as in another; very much as those who know nothing of the science of meteorology cannot see why the weather bureau should not forecast the weather for a year as well as for a day. As already remarked, an intuition, whether of man or woman, is nothing more or less than a judgment formed in the mind upon some question that is before it, and must be based upon legitimate data in some form actually brought into requisition. It must be admitted that the habit of forming instantaneous judgments is carried by many women into departments of life in which there is no store of registered experiences whereon such judgments can be correctly constructed, and, as a consequence, they are usually erroneous. It is mainly a sense of this greater liability on the part of women to err when called upon to decide any of the broader questions of society and the state, that disinclines men, and often women as well, to admit them to these fields of activity; although this is much like forbidding a child to go into the water till it has learned to swim.

Aside from the momentum, so to speak, of this instinct, inclining women to think rapidly and to judge hastily on all subjects, there is really no difference between men and women with respect to their ability to arrive at just conclusions. Differences in this respect, where they exist, are due to other things than sex, and chiefly to two causes, namely, unequal mental power and unequal information. In the first of these, as every one knows, men differ immensely among themselves; and whether the average in men is higher than the average in women may be open to question. Certainly this power is greater in many women than it is in many men. As to the second cause, it is true that the lines are more clearly drawn between the sexes; but why should they be? This is a matter that society can control, and the question is a pointed one: Should one sex be denied the means of forming sound judgments and of entertaining rational views and correct opinions on what are admitted to be the most important questions of human life? If such denial is not deemed

desirable, it can be prevented by education, though this education must be something more than can be got from books or institutions of learning. These must, indeed, be opened to woman as freely as to man, but so must also every other source of information be opened to her; and, after all, it is direct contact with the affairs of the world that fits both men and women properly to act their part in it.

Again, the fancied analogy between woman's intuition and the manifestations of genius is not merely visionary and absurd; it is an exact reversal of the true relations between these two things. As already shown, and as was necessary from the very way in which and the purpose for which it was developed, woman's intuition is essentially subjective and egoistic. It has self, or what is scarcely distinct from self, for its sole object. It is the safeguard of its possessor's personality, the loudest demand for individual existence, the strongest assertion of the will to live, and the farthest possible remove from the contemplation of truth in any form for its own sake and the concentration of the mental faculties upon the ideal and the abstract. This character it maintains even in its highest phases, and it becomes in civilized woman the embodiment of all that is prosy and practical, and the antithesis of all that is poetical and æsthetic.

Genius is the precise opposite of all this. It is purely objective and impersonal; it ignores self and despises the common things of life; it denies and shuts out the will, and concentrates the whole being upon the purely ideal and the purely abstract. In every department of art—sculpture, painting, poetry, music—in literature, philosophy, science, everywhere that true genius finds room to assert itself, the coarser wants of the body are forgotten or subjugated, the love of life and the desire for its enjoyment, preservation, and perpetuation are suppressed, and everything that belongs to the world, or that can be classed as practical, is sacrificed to the pursuit of the ideal—of abstract truth in form, color, sound, diction, thought, or fact.

But all this has long ago and many times been said. It is well known to the writer whose article is under consideration here, and the only way to account for so palpable an error on his part is to suppose his complete misconception of the fundamental nature and psychological position of the very subject of that article—woman's intuition.

It is worth while to note here that the true reason why women have always seemed to possess so little genius, relatively to men, is the predominance in them of this very intuitive faculty. From its nature, as explained above, it is incompatible with the development of great genius; and as the latter gains, the former must lose. Moreover, although genius is something more than "an unlimited capacity for work," still that hyperbole is calculated forcibly to dispel the popular illusion that it is independent of

work. It presupposes not only work, but the materials to work with. Genius is the power to bring truth out of facts, and all truth must rest upon a basis of fact. Man has displayed more genius than woman, largely because he has been in possession of a wider range of facts, a greater supply of the only material out of which genius can construct and create, viz., knowledge. And if woman is ever to display equal creative power, she too must be supplied with the same kind of raw material, for which no qualities of mind can ever stand as a substitute. But, thus supplied, there is no reason to doubt that very high flights of genius may be made by women; and their greater familiarity with the social microcosm might, as Mr. Allen suggests, give to their genius a character of its own.

According to Mr. Allen, "great men do probably owe a large element of their greatness to the imaginative faculty, and to the intuitive faculty which they derive from their mothers"; and he thinks he has observed that "men of genius were the sons of mothers in whom the feminine attribute of intuition was highly developed." In the first place, the "imaginative faculty" and the "intuitive faculty," as I have just shown, are precisely opposite faculties, intuition being purely perceptive—the best English word for the Kantian term *Anschauung*. It is directly opposed to the imagination, or the creative faculty which belongs to genius.

But aside from this slip in his psychology, there is nothing to justify what he intended to say. The popular view, expressed over and over again by philosophers, and exemplified in numberless cases by biographers, is just the reverse of this, namely, that "great men" and "men of genius" have been the sons of exceptionally *intelligent* or highly-cultivated mothers. It would be easy to enumerate a hundred cases in which high qualities have been, rightly or wrongly, ascribed to such intellectual superiority in mothers, but I have no recollection of ever seeing them ascribed to great emotional power or special intuitive perceptions. Mr. Allen probably had in mind cases in which women of real genius have been the mothers of men of still greater genius—as he confounds genius and intuition, than which no two things could be more unlike. Women of real genius have very little intuitive power. They are usually rather indifferent to the affairs of the household—the true *locus* and *focus* of that faculty.

Whether the popular theory be true or not, that theory is that women of high mental endowments, whether these come under the head of genius or talent, or under the more usual but less clearly-defined head of general intelligence, exceptional culture, mental breadth, and womanly wisdom, transmit a preponderance of these qualities to their male offspring. I am not now defending this theory, though it seems to rest upon a considerable inductive basis, and it must be true that these qualities are

transmitted as well as others. I simply wish to show that Mr. Allen has entirely misconceived and misstated it, and has proposed a theory of his own, unsupported by facts, which violates the laws of heredity and of cause and effect, in making a class of mental qualities the parent of a totally unlike and diametrically opposite class.

If there is anything in this popular theory, it goes to prove that the true way to advance the human race is to educate mothers in the widest sense of the term. They already have all the intuition they want; nature has provided this in excess of their present needs. If, as Mr. Allen, fatally to his own argument, claims, it is really increasing with civilization, surely there is no need to stimulate it artificially, and no danger of its being "educated out" of the sex. No one who has any faith in evolution can fear that such attributes as those which belong to the fundamental distinction of sex and the perpetuation of the race, can be seriously affected by any social theory or any human institution. The race is going to continue as heretofore, and if a little reduction in quantity, with corresponding improvement in quality, of our sufficiently abundant and none too perfect humanity should result from a more enlightened womanhood, the race would only be the gainer thereby. But, really, the elevation of woman to something like an intellectual equality with man, must have a tendency to increase rather than to diminish the productiveness of the race. The tendency toward sterility in the intellectually higher classes which Mr. Allen so deeply deplores, is due entirely to the fact, which he so approvingly points out, that "the sexes have diverged," and that "man has specialized himself on logical intelligence," while "woman has specialized herself upon the emotions and intuitions"; for this amounts to an admission that while man has advanced, woman has been left behind, a prey to an instinct largely out of harmony with her higher and more complex environment. Man has reached a plane of intelligence on which he cares more for intellectual companionship than for the satisfaction of the instinct to reproduce, and unless he can find such companionship in woman, he will often decline to recruit the race at the expense of his own well-being. There is therefore the added inducement that society should seek to make woman a companion for man, not through the fear that the race will not be recruited, but that it may be recruited from its highest elements, and not, as is now chiefly the case, from its lowest.

In view of all that has been said, a single reflection seems to be justified. It is pretty certain that woman's intuition, which has become, in the manner described, her habitual mode of thought, cannot be trusted in dealing with the broader concerns of human life and action. Woman must either be kept within the narrow inclosure in which that habit of thought was devel-

oped, as Mr. Allen would apparently insist upon keeping her, that is, in a condition akin to the perpetual childhood (*enfance continue*) proposed by Comte; or else, if she is let out into broader fields, she must be furnished with something besides registered experiences of an indefinite past ancestry as a basis for this mental reflex action which we call intuition. It is not at all a question of sex in mind. Unless we suppose that women possess a supernatural insight into things of which they have never heard, we must admit that they are necessarily incapable of reasoning correctly upon questions about which they have no information. And as, in spite of Mr. Grant Allen and the chivalrous band who stand with him around this little pen to keep them in, a considerable number of the precious creatures have already got out, and others are daily escaping, it would seem to be the better part of valor to make a virtue of necessity, and, accepting the inevitable, to endeavor to tame them into harmlessness, and if possible to win them back to the fold, by offering them a few grains of sense and crumbs of knowledge. There are no present indications that these would be refused.

June, 1890—Ætat. 48.

269. Notice of the Potomac or Younger Mesozoic Flora; by Wm. M. Fontaine. Monographs of the U. S. Geological Survey, Vol. XV, Washington, 1889, Text 377 pp. 4°, Atlas, 180 plates, bound separately

History.—Written May 16-17, 1890.

The American Journal of Science, New Haven, Third Series, Vol. XXXIX [Whole Number CXXXIX], No. 234, June, 1890, p. 520.

September, 1890—Ætat. 49.

270. Notice of a Revision of the Genus *Araucarioxylon* of Kraus, with compiled descriptions and partial synonymy of the species; by F. H. Knowlton. Proc. U. S. Nat. Mus., Vol. XII, 1889, pp. 601-617

History.—Written July 18, 1890.

Ibid., Vol. XL [Whole Number CXL], No. 237, September, 1890, p. 257.

September, 1890—Ætat. 49.

271. Notice of a Memoir Ueber die Reste eines Brotfruchtbaums, *Artocarpus Dicksoni* n.sp., aus den Cenomanen Kreideablagerungen Grönland's; von A. G. Nathorst. Kongl. Svenska Vetenskaps-Akademiens Handlingar, Bd. XXIV, pp. 1-10, 4°, pl. i. Separate, Stockholm, 1890

History.—Written July 18, 1890.

Ibid.

September, 1890—Ætat. 49.

272. Notice of Tertiäre Pflanzen der Insel Neusibiriens; von J. Schmalhausen. Mém. Acad. Imp. Sci. de St. Pétersburg, 7^e série, tome XXVII, No. 5, 1890, pp. 22, pl. 2, 4°

History.—Written July 19, 1890.

Ibid., pp. 257-258.

September, 1890—Ætat. 49.

273. Notice of La Flora dei Tufi del Monte Somma; by Luigi Meschinelli, Rend. R. Accad. Sci. Fis. e Mat. of Naples, April, 1890, 4°

History.—Written July 19, 1890.

Ibid., p. 258.

September, 1890—Ætat. 49.

274. Notice of Remarks on some Fossil Remains considered as peculiar kinds of Marine Plants; by Leo Lesquereux. Proc. U. S. Nat. Mus., Vol. XIII, 1890, No. 792, pp. 5-12, pl. i

History.—Written July 19, 1890.

Ibid.

October 25, 1890—Ætat. 49.

275. Origin of the Plane-trees

History.—Written May 7–24, 1890. The article is virtually a review of Jankó's memoir, which was sent me by Dr. N. L. Britton early in April, and which I read between April 7, and 11. Then I had to compare his data with my own and work up the results, which took nearly another month. I had to do all this work and write the article in my office in the midst of multifarious other duties, at spare moments and long intervals. Out of courtesy I first (July 25,) offered it to Dr. Britton for the *Torrey Botanical Bulletin*, but it was too long for that journal, so I sent it to the *Naturalist*. It may be regarded as supplementary to the one entitled: *The Paleontologic History of the Genus Platanus* (see supra, p. 152, No. 249), but none of the figures published in that article are repeated here.

The American Naturalist, Philadelphia, Vol. XXIV, No. 285, September, 1890, pp. 797–810, pl. xxviii.

October 31, 1890—Ætat. 49.

276. Notice of the Revue des travaux de paléontologie végétale, parus en 1888 ou dans le cours des années précédentes; par le Marquis Gaston de Saporta. Extrait de la Revue générale de Botanique, tome II, Paris, 1890

History.—Written Sept. 29, 1890.

The American Journal of Science, New Haven, Conn., Third Series, Vol. XL [Whole Number CXL], No. 239, November, 1890, p. 422.

October 31, 1890—Ætat. 49.

277. Notice of Notes on the Leaves of
Liriodendron; by Theodor Holm. Proc.
U. S. Nat. Mus., Vol. XIII, 1890, pp.
15-35, pls. iv-ix, Washington, 1890

History.—Written Sept. 29, 1890.

Ibid., pp. 422-423.

November, 1890—Ætat. 49.

278. Administrative Report for the year
ending June 30, 1888

History.—Written June 22-29, 1888.

Ninth Annual Report of the United States Geological Survey, 1887-'88,
Washington, 1889, pp. 128-131.

279. Nervation

History.—Illustrations selected and drawings made under my direction Jan. 21–27, 1890. Definition written Jan. 29–30, 1890. The proof was read in March 5, 1890. This is the only one of the many thousand definitions that I have written for the *Century Dictionary* and Webster's *International Dictionary*, which I include in this work. The reason is not that it is the longest, for there are probably many other longer ones. It is because it is so exclusively my own original work, none of my assistants on the *Dictionary* having had anything to do with it (except the draftsmen, who merely worked mechanically in reproducing the figures that I gave them to copy). Moreover, I was probably at the time the only person who could have written the definition. All the dicotyledonous leaves figured were collected, named, and described by me, and I had made a special study of the subject of nervation, so vital to the knowledge of fossil plants (see *supra*, p. 193).

The *Century Dictionary*, New York, Vol. IV, 1890, p. 3970, 9 figs.

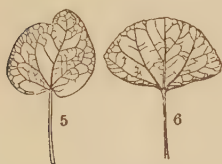
Nervation (nér-vā'shon), *n.* [= F. *nervation*; as *nerve* + *-ation*.] The arrangement or distribution of nerves. Specifically—In *bot.*, the disposition of the fibrovascular bundles in the blades of leaves, the sepals or petals of flowers, the wing-like expansions of samaroid fruits, etc.: a character which has assumed special importance in the study of fossil plants, since it has been proved to have generic rank, while the form and outline of leaves have only specific rank. The nervation of leaves, as studied and classified by A. P. de Candolle (1827), Giuseppe Bianconi (1838), Baron von Ettingshausen (1854–61), Oswald Heer (1856), and later authors, is based primarily on the relative rank of the nerves, and secondarily on their course through the leaf. As regards the rank of the nerves, the leaves of



Figs. 1 to 9 show varieties of nervation of fossil leaves.

1, pinnately nerved camptodrome leaf of *Ficus Crossii*, from the Cretaceous (Laramie) of Colorado; 2, pinnately nerved craspedodrome leaf of *Ulmus planeroides*, from the Fort Union group of Montana; 3, marginal nervation of a leaf of *Eucalyptus*, from the Cretaceous of Martha's Vineyard; 4, acrodrome leaf of *Zizyphus*, from the Cretaceous of Montana.

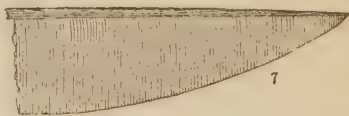
dicotyledonous plants are usually either pinnately or palmately nerved. This refers to the primary nerves.



5, palmately nerved brochidodrome paryphodrome leaf of *Cocculus Haydenianus*, from the Fort Union group of Montana; 6, palmately nerved leaf of *Hedera Bruneri*, from the Cretaceous (Laramie) of Wyoming.

In pinnately nerved leaves there is only one primary nerve, the midrib, which may be regarded as a continuation of the petiole, and from which there are given off secondary nerves which proceed at various angles through the blade toward or to its margin. These secondaries may or may not give off other nerves called tertiaries, and even these may produce quaternary nerves. In palmately nerved leaves there arise, usually from the summit of the petiole, two or more (sometimes numerous) more or less divergent primary nerves, which may have nearly equal strength, but more commonly the central one is thickest and may still be denominated the *midrib*. In the latter case the others are called *lateral primaries*. Any or all of the primaries of a palmately nerved leaf may give off secondaries as in pinnately nerved leaves, but these more commonly proceed from the outer pair. Leaves of

only three primaries are sometimes called *triplinerved*; those of five, *quintuplinerved*. Peltate leaves usually have a peltate nervation, which may be regarded as a modification of the palmate nervation. The pedate nervation is simply a case of palmate nervation in which there are several nearly equal primaries. The terms *penninerved*, *palminerved*, *peltinerved*, and *pedalinerved* were suggested by De Candolle for these several kinds of leaves. As regards the course of the nerves through the blade and their ultimate disposition the following classes are distinguished: (1) *craspedodrome* [



7, transversely parallelodrome nervation of *Macrotanopteris magnifolia*, from the Trias of Virginia.



8, longitudinally parallelodrome nervation of a fossil palm-leaf, from the Fort Union group of Montana; 9, campylodrome leaf of *Oreodoxites plicatus*, from the Cretaceous (Laramie) of Colorado.



(2) *campylodrome* [brochidodrome [acrodrome [dictyodrome [nervilles, below); (6) *hypodrome* [paryphodrome [marginal, a distinct nerve passing along the margin of the leaf, parallel to it, but separated from it by a narrow

interval; (9) *parallelodrome* [$<$ Gr. παράλληλος, parallel], the nerves running parallel to one another, either longitudinally, as in grasses, or horizontally from the midrib to the margin, as in the banana-tree; (10) *campylodrome* [$<$ Gr. καμπύλος, curved], the nerves passing in a gentle curve from base to apex of the leaf, the interval between them increasing gradually in width from either end to the middle. The last two classes are almost wholly restricted to monocotyledonous plants. Besides the above, there is the *dichotomous* or *forking* nervation of most ferns and some other plants. From the various nerves as thus described there usually proceed many much finer ones which join and anastomose in various ways, forming a network of meshes of different shapes, usually angular, and either rectangular, trapezoidal, or nearly square, the spaces inclosed by which are known as *areolæ*. To such nerves the term *nervilles* has been applied. Physiologically considered, all nerves consist of vascular bundles which pass from the branch through the petiole, if there is one, into the base of the leaf, the primary fascicle of which is subsequently divided up to furnish the various nerves of the leaf, the primary nerves further dividing to supply the secondaries, these to supply the tertiaries, etc., and no nerves or fibers originate within the leaf.

January (?), 1891—Ætat. 49.

280. Report on the Department of Fossil
Plants in the U. S. National Museum
[for the year ending June 30], 1888

History.—Written Oct. 8–10, 1888.

Annual Report of the Board of Regents of the Smithsonian Institution
for the year ending June 30, 1888. Report of the U. S. National
Museum, Washington, 1890, pp. 189–190.

January (?), 1891—Ætat. 49.

281. Report on the Department of Recent
Plants in the U. S. National Museum
[for the year ending June 30], 1888

History.—Written July 8–10, 1888.

Ibid., pp. 191–193.

January (?), 1891—Ætat. 49.

282. Bibliography for the year ending June 30, 1888

History.—Written in July, 1888.

Ibid., p. 733.

LESTER F. WARD. Report on the Department of Plants in the U. S. National Museum 1885.

Report of the Smithsonian Institution, 1885 (1886), Part II, pp. 135, 136.

- Remarks on Lesquereux's criticisms of the Synopsis of the Flora of the Laramie Group.

Amer. Jour. Sci., xxxiv, 3d series, December, 1887, pp. 488, 489.

Points out the greater abundance of palms in the southern than in the northern (Fort Union) Laramie deposits, and defends the Senonian age of certain of the Credneria beds of Europe.

- Remarks on Dr. Welling's paper on the Law of Malthus, read before the Anthropological Society of Washington, February 1, 1887.

The American Anthropologist, I, No. 1, January, 1888, pp. 21-23.

The Malthusian law applicable to the animal kingdom below man, as shown by Darwin, who has simply applied it to it, but not applicable to man himself in consequence of the great development in him of the psychic faculty whereby he controls the rest of nature and makes himself an exception to its laws.

- Review of W. C. Williamson: On the Organization of the Fossil Plants of the Coal Measures. Part XIII.

Amer. Jour. Sci., xxxv, 3d series, March, 1888, p. 256.

- Review of C. T. Stockwell on The Evolution of Immortality or, Suggestions of an Individual Immortality based upon our Organic and Life History.

Public Opinion, Washington and New York, IV, March 24, 1888, p. 592.

LESTER F. WARD. Some Social and Economic Paradoxes.

Science, XI, April 13, 1888, pp. 172, 174-176.

Discusses and defends the following paradoxical propositions: (1) The artificial is superior to the natural; (2) The arbitrary control of the social forces is economical; (3) Reforms are chiefly advocated and brought about by those who have no personal interest in them; (4) Discontent increases with the improvement of the social condition; (5) The means of subsistence increases more rapidly than population; (6) Capital is more effective than labor in the production of wealth; (7) Wages are drawn from products, not from capital; (8) Profits rise with wages; (9) Prices fall as wages rise; (10) Rents rise with wages; (11) A reduction of the hours of labor tends to increase production; (12) The reduction of hours tends to increase wages.

February, 1891—Ætat. 49.

283. [The Unearned Increment of Machine-made Wealth]

History.—Remarks on the paper of Prof. Henry C. Adams entitled: *Is Civilization just to Workingmen*, read Jan. 12, 1891, before the True Commonwealth Club of Washington, D. C. Written out Jan. 13-14, 1891.

The True Commonwealth, Washington, D. C., Vol. I, No. 11, February, 1891, p. 165.

ADMITTING, as the essayist has shown, that in the great increase in the production of wealth which has been brought about by machinery, due to the fact that thereby the forces of nature have been made to do the greater part of the work for which no wages are paid, the working man does not receive an equitable share of the surplus thus created, the question arises, how can such an equitable distribution of what I may call *the unearned increment of machine-made wealth* be brought about?

It is clear that the present competitive system can never accomplish this. Its tendencies are in the opposite direction. It would seem, therefore, that unless human nature undergoes a great change, which it is not likely to do, such a result can only be looked for through the action of society itself, considered as a conscious and intelligent organism, capable of understanding its own interests and of rationally adopting the means necessary to secure them precisely as an individual sets about the making of his fortune and the disposition of his effects.

This may, it is true, be regarded as a vague presentation of the subject, and something more definite, tangible, and intelligible may be demanded. But it would never do to say that the equitable distribution of wealth should be undertaken by Government, in the present sense of that word. Such a suggestion

would raise a storm of objections, with the nature of which you are all too familiar. Nor is this at all what is meant. It would be impossible for the present empirical and fundamentally unscientific governments of the world to enforce the equitable distribution of production. As already remarked, if ever done, it must be done by society grown wise enough to see that this is not only right, but advantageous. Between existing government and society so organized as to do this, there is an immense chasm. And yet there are some, I had almost said so visionary, I will rather borrow the original expression of our essayist, and say so "poetic" in their mental make-up as to conceive this chasm gradually closed, and to imagine our poor imperfect Government taking on the glorious proportions which shall make it capable of grappling with the problems of social destiny.

April, 1891—Ætat. 49.

284. Notice of Handbuch der Palæontologie herausgegeben von Karl A. Zittel. II. Abtheilung, Palæophytologie; bearbeitet von Prof. W. Ph. Schimper und Dr. A. Schenk. München und Leipzig, 1879-1890

History.—Written Feb. 9-13, 1891.

The American Journal of Science, New Haven, Conn., Third Series, Vol. XLI [Whole Number CXLI], No. 244, April, 1891, p. 330.

April, 1891—Ætat. 49.

285. Notice of Monographie der baltischen Bernsteinbäume; von H. Conwentz. Danzig, 1890. 4°. 151 pp., 18 colored plates

History.—Written Feb. 9-13, 1891.

Ibid., pp. 330-331.

April, 1891—Ætat. 49.

286. Notice of a memoir Ueber die Fructification von *Bennettites Gibsonianus* Carr.; von H. Grafen zur Solms-Laubach. *Botanische Zeitung*, Vol. XLVIII, Leipzig, 1890, col. 789-798; 805-817; 843-847, pl. ix, x. Also separate

History.—Written Feb. 9-13, 1891.

Ibid., p. 331.

April, 1891—Ætat. 49.

287. Notice of Die fossile Flora von Schönegg bei Wies in Steiermark; von Prof. Dr. Constantin Freiherrn von Ettingshausen. I. Theil. *Denkschr. d. math.-naturw. Cl. d. k. Akad. d. Wiss.* Wien, Bd. LVII, Wien, 1890, 52 pp. 4 pl. Also separate

History.—Written Feb. 9-13, 1891.

Ibid., pp. 331-332.

April, 1891—Ætat. 49.

288. Notice of Das australische Florenelement in Europa; von Dr. Constantin Freiherrn von Ettingshausen. Graz, 1890. 10 pp., 1 pl. 4°.

History.—Written Feb. 14, 1891.

Ibid., p. 332.

April, 1891—Ætat. 49.

289. Notice of Untersuchungen über Ontogenie und Phylogenie der Pflanzen auf paläontologische Grundlage; von Prof. Dr. Constantin Freiherrn von Ettingshausen und Prof. Franz Krašan, Denkschr. d. math.-naturw. Cl. d. k. Akad. d. Wiss. Wien, Bd. LVII, Wien, 1890, 36 pp. 5 pl. Also separate

History.—Written Feb. 14, 1891.

Ibid.

April 27, 1891—Ætat. 49.

290. The Transmission of Culture

History.—Written Feb. 2, to March 14, 1891. This article was ordered by Mr. Metcalf on the occasion of his visit to Washington on Jan. 19. I told him I wanted to apply the doctrines discussed in my presidential address on Neo-Darwinism and Neo-Lamarckism (see the next article) to the problems of education. The title adopted by me was: *Is Education Hereditary?* and the aim was to show that it was not, and must be acquired anew by every member of society. Mr. Metcalf left the *Forum* while this article was in press and may not be responsible for the change in the title, which was made without consulting me. It is a complete misnomer in that it expresses exactly the opposite idea from that which it was the purpose of the article to maintain. But it is euphonious and calls up the two leading thoughts, heredity and culture, and it is doubtful whether any reader of it ever noticed the contradiction. This paper was read in a much expanded form on Jan. 5, 1892, before the Anthropological Society of Washington with the title: *Are the Acquired Mental Faculties of Man Hereditary?* For other echoes of it, see the next article.

The Forum, New York, Vol. XI, No. 3, May, 1891, pp. 312-319.

A GREAT prophet of science has arisen, in the person of Professor August Weismann, of Freiburg, who has essayed* to prove that what biologists call an "acquired character" is not hereditary. An acquired character is one that is not congenital, but has arisen, no matter how, since the birth of the organism possessing it. Professor Weismann naturally confines himself chiefly to animals and to modifications that take

* *Essay upon Heredity and Kindred Problems*. Authorized translation (Oxford, 1889).

place in their physical structure, and he maintains that wherever such modifications descend to the offspring of such animals they cannot have been acquired by the animals during their lives, but must have previously existed in a latent state in the reproductive germs, and have been handed down from ancestors more or less remote. Mr. Francis Galton had anticipated Weismann in the expression of similar views, but he made them less absolute, and did not insist upon them with so great emphasis. He applied them, too, chiefly to man, and dealt with mental as well as with physical qualities. With the mental qualities of the human race, we are just now exclusively concerned, and we must leave the biologists to settle the question as regards animals and plants.

Weismann could not, of course, wholly ignore mental qualities, and the following passage from his book will serve to show that he does not exempt them from his law. At the same time, it may be taken as a sample of his reasoning and as a sort of text for what is to follow. He says:

"The children of accomplished pianists do not inherit the art of playing the piano; they have to learn it in the same laborious manner as their parents acquired it; they do not inherit anything except that which their parents also possessed when children, viz., manual dexterity and a good ear. . . . The pianist may by practice develop the muscles of his fingers so as to insure the highest dexterity and power; but such an effort would be entirely transient, for it depends upon a modification of local nutrition which would be unable to cause any change in the molecular structure of the germ cells, and could not therefore produce any effect upon the offspring."

It may be observed that this passage contains two very distinct statements, which are confounded by Weismann, and have been generally confounded by writers on heredity. It is perfectly true that "the children of accomplished pianists do not inherit the art of playing the piano." But "the art of playing the piano" is really a form of knowledge, and no one has ever maintained that knowledge can be transmitted. It is necessary to distinguish sharply between knowledge and the capacity for acquiring knowledge. It is this latter only that has been generally believed to be hereditary.

Knowledge is of two kinds, subjective and objective—knowing how and knowing what. The former is the knowledge of handicraft, or art; the latter is the knowledge of facts and their relations, or science. Neither can be acquired except through the senses, and both have to be learned by repetition and memory. It is as absurd to say that a knowledge of piano execution can be inherited as it would be to say that a knowledge of the multiplication-table can be inherited. Both require a prolonged mnemonic drill of the appropriate faculties. To learn to play the piano it is necessary to learn what a piano is, how its keys are arranged, and how its tones are adjusted. It is also usually necessary to acquire the rudiments of European music, to which

the piano is adapted, to learn to read written music, and to understand the relations of the musical characters on a sheet of music to the corresponding keys of the instrument. This does not differ from learning to read print, and certainly no one claims that the ability to read can be inherited. I have dwelt somewhat upon this point, because, simple as it may seem, no one has touched upon it in the prolonged discussion of Weismann's theories, and statements such as this have been allowed to weigh against the transmission of acquired characters. Being so obviously true, they have been supposed to have peculiar force, when in fact they have no force at all, because they are wholly irrelevant.

The remainder of the passage quoted is to the point, and in view of the state of popular opinion on such subjects, would doubtless be generally rejected as contrary to common observation. But we live in an age when popular beliefs are being constantly put to the test of exact science. Mere prevalence of opinion is no longer a legitimate ground for accepting any proposition. The most universal and long-standing dogmas have proved untrue, while the unpopular heresies opposed to them have often been found to correspond much more nearly to the reality. Is the doctrine of the transmissibility of mental aptitudes acquired through education—using that word in its widest sense—to be relegated to the limbo of exploded beliefs? And is the opposite proposition the true one—that acquired talents cannot be passed on to a future generation?

Such is the problem before us, and its immense importance must be obvious at a glance. Its settlement, supposing that it can be settled, must profoundly influence the action of every class of men who are sincerely working for the good of the race, and the side of this question which each individual espouses cannot but determine his course in everything that he undertakes. The educationalist must be governed by it in all his plans for human culture. The social reformer will be guided by it in all schemes for the improvement of society. Even the statesman and the legislator cannot fail to be affected by it, and will shape the policy of the state in a very different way for a race that is to develop through its own exertions, from the way in which they would shape it for a race that is completely at the mercy of the little-known processes of "natural inheritance."

Nor is the question now, viewed from the standpoint of scientific authority, any longer a one-sided one. In England, aside from Mr. Galton, there are to be counted among the followers of Weismann such eminent scientific specialists as Mr. W. T. Thistleton Dyer, Director of Kew, Prof. E. Ray Lankester, and, so far at least as animals are concerned, Dr. Alfred Russel Wallace. Led by such lights as these, perhaps one half of the biolo-

gists of England have subscribed, with or without qualification, to the Weismannian doctrine.

So long as the question is confined to the lower forms of life, it must be confessed that the defenders of the transmissibility of acquired characters are placed at a disadvantage, on account of the difficulty of proving that the facts to which they point are not capable of a different interpretation, and that they may not be equally well explained by the all-embracing law of natural selection. But when the human species is to be treated, the tables are, in a manner, turned. Dr. Wallace, co-discoverer with Darwin of the law of natural selection, has denied from the first that that law applies without qualification to man. His defense, therefore, of Weismann's views constitutes a singular anomaly. But the fact that, in attempting to account for the development of the human faculties, he abandons the scientific method and, in the language of Prof. E. Ray Lankester, "has recourse to a metaphysical assumption," does not invalidate his early claim. That claim was that such development cannot be due to the action of natural selection, since this can operate only where the quality to be developed possesses such a direct advantage in the struggle for existence as to increase the chances of reproduction and to insure the survival of those individuals endowed with it.

So far as the development of brain mass and consequent brain power is concerned, it must be conceded that no "character" could possibly be more directly the subject of natural selection, since the primal quality of brain is cunning, and this is more important in fitting a creature to survive than any other attribute. It is, therefore, only in the cases of certain derivative faculties that have little or nothing to do with the fitness to survive, many of them rendering man unfit and almost helpless in the struggle for existence, that we find the really strong claims of those who advocate the doctrine of the inheritance of acquired mental qualities, or post-natal increments to faculties already existing. What are these qualities? Dr. Wallace believes them to consist chiefly of the mathematical, the esthetic (sculpture, painting, etc.), and the musical; but he also very properly mentions the power of abstract reasoning, the metaphysical faculty, or talent for abstruse speculation, that which gives rise to wit and humor, and the moral or ethical attributes. Others might be enumerated, such as the talents for scientific observation, for laboratory experimentation, for mechanical invention, and for literary research; and, in general, all the powers of mental application, abstraction, and attention, of study, and of investigation, by which knowledge has been increased. On the side of art might be added also the faculty of diction, both written and spoken, poetry, oratory, and style in writing.

It is certainly not necessary to explain that these biologically non-advantageous attributes, though highly derivative and with-

out any place in the great scheme of organic development, have become to civilized and enlightened man not only the most advantageous of all his mental possessions, but the chief marks by which he is distinguished from the animal world below him. More than any and all physical distinctions, these constitute him man. Yet all derivative faculties do not belong to this class, for that of money-getting, whether in legitimate business ways or by sharp speculation, that of political and social intriguing to better one's condition, and many others, are but so many refined modifications of the primitive animal cunning, calculated to evade the protective institutions of society, and to secure by still greater indirection the personal advantages no longer attainable by brute force or sagacity. These have, therefore, developed through the survival of the fittest, and belong to the normal competitive class characteristic of the lower animals.

It is quite otherwise with those higher intellectual, esthetic, and ethical faculties first enumerated, and this is admitted by Weismann when he says that "predispositions which we call talents cannot have arisen through natural selection, because life is in no way dependent upon their presence." But he denies that they are due to the inheritance of what is gained by individual effort, and asserts with emphasis that "there is absolutely no trustworthy proof that talents have been improved by their exercise through the course of a long series of generations." He reminds us that men who have displayed special talents have most commonly been the only persons in their lines who have possessed such; that others are known to have inherited them, not from their parents directly, but from more or less remote ancestors; that quite varied talents have often cropped out in the same family; that highly-gifted men frequently emerge from the masses; and that great events are certain to evolve appropriate leaders of any popular movement. Therefore, he argues, such powers of mind must be due to certain subtle influences at work through heredity in society; and the commingling of innumerable and widely-different ancestral germs, co-operating with favorable conditions for their manifestation, must suffice to explain the observed facts. Dr. Wallace offers a very different explanation, and holds that the facts "clearly point to the existence in man of something which he has not derived from his animal progenitors—something which we may best refer to as being of a spiritual essence or nature, capable of progressive development under favorable conditions."

On the other hand, Mr. Galton, although leaning strongly against the doctrine of the transmission of acquired qualities, has, in his "Hereditary Genius" and other works, ably shown from concrete examples that high qualities of mind tend to run in particular families, and has done much to disprove the popular notion, relied on by Weismann, that they are spasmodic

products of the *Zeitgeist*. In the same line with Galton, M. Alphonse de Candolle, himself a notable example of "hereditary genius," has collected an additional mass of facts in support of the view that talents tend to persist in certain families or lines of descent. There are, it is true, many apparent exceptions to this rule, but most of them could probably be explained if all the facts were known. It is not to be supposed that there will be in every case a series of direct descendants, all displaying the same mental powers in a progressively increasing degree. Aside from the now well-understood law of atavism, which often makes long breaks in such series, a multitude of other influences tends to modify and distort the effects, and finally wholly to destroy them. The most important of these influences is, of course, the commingling of different strains in the two parents. The single fact that, as a rule, the sexes prefer their opposites would rather make us wonder that any one class of mental qualities can be perpetuated through two generations. And it is the recognition of this fact that has led some to propose an abandonment of the rule of personal choice, and to recommend the selection by parents and guardians of similar natures, instead of opposite ones, to be the parents of the race. But such persons forget that in the union of opposites nothing is lost of the qualities of either, but only the tendency to extremes is checked. And, assuming the qualities thus neutralized to be worthy, many maintain that this leavening of the whole mass of society is more to be desired than the exaggeration of a few of even the noblest attributes.

Weismann and his followers do not generally deny that the faculties above enumerated have increased, and greatly increased. The chief explanation seems to be that this is effected by the fortunate union of varied ancestral qualities in the developing germ. Prof. E. Ray Lankester argues that they may have arisen more or less suddenly, as in the case of what are called "sports," and that this may be brought about by external influences acting abruptly and spasmodically upon the reproductive elements of the parents. He denies that the nature of the effect can have any qualitative relation to the cause, and compares this relation to that which the shaking of a kaleidoscope sustains to the change produced in the images exhibited. To the average mind this certainly seems far less reasonable than to suppose that the prolonged exercise and intense activity of a particular faculty have the effect, in some unexplained way, of producing in the parental germ a corresponding alteration which is capable of perpetuating itself in the offspring, and thus of transmitting to descendants the increment acquired by the parent through cultivation and personal exertion.

But aside entirely from all abstruse theories as to how heredity takes place, we have at least the following general facts, which can best be explained by the theory of the transmission of

acquired qualities: Correlated with the general process of cephalization, which is admitted to be due to other causes, a large number of highly derivative and greatly specialized mental attributes that offer no advantage in the struggle for existence have made their appearance in man. These have arisen, so far as we know, only under the protection of such social institutions as are calculated to exempt a portion of the race, for longer or shorter periods, from the necessity of devoting its energies exclusively to the maintenance of physical existence; that is to say, they are the products of leisure, and represent the surplus mental energy insured by civilization. With the satisfaction of physical wants these intellectual, esthetic, and ethical wants have arisen, grown powerful, and been attended with intense emulation. This has led to the incessant and vigorous exercise of these derivative faculties. Although not advantageous in the biological sense, these faculties have, nevertheless, been strengthened and increased *pari passu* with their exercise. They are most highly developed in those persons who have most strenuously cultivated them, as witness the ethical cast of the Hebrew mind, the talent for sculpture among the Italians, and the musical genius of the Germans. The faculties themselves are clearly hereditary and, notwithstanding parental crossing and other distributive influences, tend perceptibly to persist for a longer or shorter period in particular families.

The whole point at issue is whether there is a causal relation between the cultivation of these faculties and their development; in other words, whether the increment gained by their exercise is transmitted to posterity. Professor Weismann and most of his followers, constituting what is now generally known as the school of Neo-Darwinians, deny such transmission. If they are right, education has no value for the future of mankind, and its benefits are confined exclusively to the generation receiving it. So far as the inculcation of knowledge is concerned, this has always been admitted to be the case, and the fact that each new individual must begin at the beginning and acquire all knowledge over again for himself is sufficiently discouraging, and has often been deplored. But the belief, though vague, has been somewhat general that a part at least of what is gained in the direction of developing and strengthening the faculties of the mind, through their life-long exercise in special fields, is permanently preserved to the race by hereditary transmission to posterity of the acquired increment. We have seen that all the facts of history and of personal observation sustain this comforting popular belief, and until the doctors of science shall cease to differ on this point and shall reduce the laws of heredity to a degree of exactness which shall amount to something more like a demonstration than the current speculations, it may perhaps be as well to continue for a time to hug the delusion.

May 27, 1891—Ætat. 49.

291. Neo-Darwinism and Neo-Lamarckism*

History.—Written Oct. 21, to Dec. 25, 1890. Extensively revised and enlarged during January, 1891, and typewritten in duplicate Jan. 12–21. The following points may be noted in the history of this address: On January 11, 1890, I was reelected president of the Biological Society of Washington. I should say that this was no special honor, as it had been the uniform practice of that Society to have a president serve two years, so as not to run out of “presidential timber.” But it entailed the preparation of another address, and I was at a loss for a subject. Weismann’s *Essays* appeared in English about that time and the biological atmosphere was soon filled with that subject, and I decided to make it that of my address. But I had many other things in hand, and did not even obtain a copy of the book until May 31. I was then just starting on an extended geological campaign with Prof. William M. Fontaine and Mr. Charles S. Prosser in a buckboard over the Triassic terrain of Maryland and Virginia, which occupied 18 days (June 2–20), during which we depended for food and lodgings on the people among whom our work required us to sojourn. But I took the book along and read the most of it evenings, often by very poor light. It was finished early in September, and I then went carefully through it and made slip notes from the marginally annotated passages to be used in preparing my address. I also read Spencer’s *Factors of Organic Evolution*, and the early works of Galton bearing on

* Annual Presidential Address delivered at the Eleventh Anniversary Meeting of the Biological Society of Washington, January 24, 1891, in the Law Lecture Room of the Columbian University.

the subject, which had been overlooked by Weismann, as he admits in his *Germ-plasm*. Finally, in December, I took up the volumes of *Nature* and went systematically through them, reading everything relating to heredity, and weaving all into my address. Considerable matter was added after the address had been delivered, and before I gave it to the Committee on Publications, for I continued to read in the works of Eimer, Geddes, Thompson, Semper, Cunningham and other writers, as I note them in their places. It went to press in March, 1891, and I received my reprints on May 27, which was just one month later than the appearance of my article in the *Forum* on the *Transmission of Culture*, although that was only an overflow, as it were, from this, and was written after the address was delivered. I had 200 reprints of the address struck off as a neat-covered pamphlet, but did not distribute them all gratuitously. Mr. Hodges, Editor of *Science*, offered to advertise and sell the pamphlets. I sent him 100 copies and he disposed of 76 at 25 cents each. My stock was getting low, and in May, 1894, I asked him to return the balance which he did. Very few remain at this writing (May 12, 1910).

Many of those to whom I sent copies of this and the *Forum* article replied, and some of the letters are important. Professor Cope, who was present and heard the address, wrote that he would like to reprint it in the *American Naturalist*. I do not know why I did not let him do so. I now see that it was a mistake. I suppose it slipped my mind, as his letter is dated Feb. 2, or soon after it was delivered. Perhaps the most important letter I received was from Alphonse de Candolle. It is dated Geneva, July 7, 1891. After acknowledging the receipt of this address and the article on the *Transmission of Culture*, he says, among other things:

"It seems to me that the Neo-Darwinists depart far from the safe and scientific method of the great Darwin. They and Weismann, to whom you perhaps give undue importance, quarrel (*dissentent*) over theories and hypotheses, and fall into subtleties, instead of searching after facts and striving fully to understand those which science possesses. Darwin accumulated the facts observed by others and by himself, then he did propose theories, though rarely, for example, Pangenesis, taking great care to say that it was a hypothesis. He is an admirable model for any man who is working in the sciences of observation. The post-Darwinists sometimes make innovations through their ignorance of facts duly established and published. Thus many deny

that accidental lesions are more or less transmitted by heredity. Here is a fact which I recounted as early as 1885, and of which I have had more recent confirmation.

"In 1797 a young lady of 21 years had a fall from a carriage, in which, having fallen upon a sharp rock, she had a serious wound above the left ear. The wound healed, but there was never any hair on the new skin. Marrying in 1799, she had a son who bore in the same spot on his head a space devoid of hair. This son had a son who did not have the mark. He resembled his mother more than his father. But the son of this latter showed me in 1885 and again in 1891, an elongated space deprived of hair on the spot where his great grandmother had been wounded. Thus, in spite of alliances with other families, the wound has been transmitted to the third generation, with the exception of the intermediary one. When the present young man marries it will be interesting (*curieux*) to know whether he will have children marked like himself. It seems that the hairless space is diminishing; from oval it has become elongated several inches and narrow.*

"In order that a lesion be transmitted it must be serious and on an important organ. Saber gashes on the cheeks of German students are not transmitted, nor, as it seems, the ablations practised by the Jews.

"A mass of facts prove that moral and intellectual characteristics (*dispositions*) are transmissible the same as physical characters. There are also accidental lesions of the moral and intellectual order, for example, intemperance, a great fright, a great fatigue, etc. Their transmissibility has sometimes been established. In 1885 I augured ill for the generation produced at Paris in the frightful disorders of 1871, on account of the number of inebriates (*alcooliques*), of brigands, and of starved wretches of that year. The quantity of horrible crimes committed by young persons at Paris within the last few years leads me to think that my prediction was well-founded.

"For the development of men of science my researches show that *nurture* is more important than *nature*. There are 19 causes which favor the production of scientific men in a country and heredity is only one of these causes."

I translated this letter and on Dec. 26, 1891, I gave a paper before the Biological Society of Washington on *Alphonse de Candolle on the Transmission of Acquired Characters*, in which I read the letter to the Society and discussed the questions involved. I also read the letter to the Anthropological Society on Jan. 5, 1892 (see *supra*, p. 246), laying special stress on the transmission of moral and intellectual qualities.

Prof. Henry F. Osborn, in his letter of Aug. 17, 1891, asked:

"What is it in the American climate or soil which makes us incline to the Lamarckian side, however much we may desire to take an unbiassed view of the question?" And he adds: "Prof. Lancaster in speaking of, or rather acknowledging, one of my papers (which you speak of so kindly), says he is

* The family of which I am speaking is one of the principal ones of our city.

interested but finds neither *a-priori* nor *a-posteriori* grounds for the least change of opinion. I wrote to Poulton lately that whatever logic may exist on this side turns into sophistry in crossing the Atlantic."

Professor J. H. Comstock, in a letter dated Nov. 17, 1891, said:

"It is a magnificent treatment of the subject and pricks the Weismann bubble. Before writing to you I had just finished reading Weismann's *Essays* and was anxious to get something on the other side. I think your statement of Weismann's views is wonderfully fair and judicial, and your refutation of them very complete."

In a letter from Prof. A. S. Packard dated Dec. 10, 1891, after calling my attention to papers of his which I had overlooked, and saying that he used the form "Neo-lamarckism" (changed from "Neolamarckianism," previously used by him) in 1890, he adds:

"I like what you say in regard to the transmission of acquired characters. I do not see how we can have continuous evolution without it, and do not see that Weismann's experiments have gone to the bottom of the matter."

Professor Haeckel, in his *Systematic Introduction* to Semon's *Phylogenie der australischen Fauna*, 1893, p. IX, characterizes my address as "eine treffende allgemeine Kritik"; and Dr. Andrew D. White says in a footnote to one of his *New Chapters in the Warfare of Science*:

"For a characteristically lucid statement of the most recent development of evolution doctrines, and the relations of Spencer, Weismann, Galton, and others to them, see Lester F. Ward's *Address as President of the Biological Society*, Washington, 1891."*

Dr. Alfred Russel Wallace at least did me the honor to criticize both this address and the *Forum* article, quoting passages from both. His attempts to meet my arguments are characteristic of all his utterances on this subject.† Weismann himself also criticized it in his *Germ-plasm* (p. 408). In a footnote he says:

"Cf. the essay directed against my views by this author [Lester F. Ward] (*Neo-Darwinism and Neo-Lamarckism*, Washington, 1891), which is written from the thoroughly objective and truly scientific point of view."

* *Popular Science Monthly*, New York, Vol. XLV, No. 8, June, 1894, p. 160; *A History of the Warfare of Science with Theology in Christendom*, New York, 1897, Vol. I, p. 88.

† *Human Progress: Past and Future*, *The Arena*, Boston, Vol. V, No. 2 [26], January, 1892, pp. 153, 158.

On pages 8-9 he admits that he was ignorant of Galton's early papers when he wrote his *Essays*. It is probable that he gained his first knowledge of them from my address.

Proceedings of the Biological Society of Washington, Washington, D. C., Vol. VI, pp. 11-71; also separate.

INTRODUCTORY.

IN casting about for a subject on which to address this Society I have encountered serious difficulties. A presidential address to a Biological Society should, as it seems to me, follow one of two courses. It should either relate in its general aspects to the subject with which its author is most familiar, and so coordinate the facts within his specialty as to correlate them with the sum-total of biological science; or else, it should be an exposition of and commentary upon the most prominent problem of biology which at the time of its presentation, is engrossing the attention of the scientific world. One year ago I realized these two alternatives as clearly as I do now, and I felt then that while the second of them was not more appropriate than the first, the overwhelming prominence of one great biological question almost demanded that I should sink my individual preferences and, as a matter of sheer duty, undertake to grapple with that question. But I have always believed and often said that the Biological Society should choose as its president one who represents the whole science of biology, and that it made a mistake in selecting a narrow specialist, and a specialist in a department which has the reputation of not keeping pace with the rest of the science, and I felt that if compelled to listen to views growing chiefly out of that narrow specialty, it was in some degree its own fault. But in view of the fact that the Society saw fit to repeat its mistake, and that I last year presented the problems of botany and its geologic history, there seems no escape from that duty which still confronts me of closing with the great problem of heredity which continues to occupy the foreground of all biological discussion.

There is strictly speaking only one prominent question before the biological world and that is the question whether qualities that are acquired after birth are capable of being transmitted to descendants. Darwinism in its original entirety, as expounded by Darwin himself, admits such transmission. But by the new school of Neo-Darwinists this is denied. On the other hand Lamarckism, as expounded by Lamarck, explains all change through the transmission of functionally acquired characters, the law of natural selection not having been perceived by Lamarck. But Neo-Lamarckism, as I understand it, while recognizing

natural selection as the more potent of the two agencies, also recognizes that the increments of change impressed upon individuals during their lifetime or brought about by individual efforts or habits are also perpetuated in some measure through heredity and form an important factor in the general process of organic development.

STATUS OF THE PROBLEM.

From the appearance of the *Origin of Species* in 1859 until within the past four or five years it had been the opinion of nearly all naturalists that the existing forms of animals and plants were the result mainly of two cooperating causes, one of which may be called *functional* and the other *selective*. The multitudinous infinitesimal effects wrought by both of these causes upon the form and character of organisms were believed to be cumulatively perpetuated by heredity in the modification of species and the production of new and altered forms of vegetable and animal life. Prior to the date named the few who conceived that existing forms might be modifications of ancestral ones ascribed the changes wholly to the first of these causes, the functional. Mr. Darwin showed that this could not account for all cases, and in pointing out, simultaneously with Mr. Wallace, the existence and mode of operation of the selective agency he made the most important contribution yet brought forward to the science of biology.

At the date of Darwin's death, 1882, the general doctrine of evolution and the theory of development in biology had been accepted by so nearly the entire body of scientific men that it was scarcely worth the effort to conciliate the small remnant who still adhered to the special creation hypothesis. The only question was: By what agency or agencies is evolution accomplished?

It would carry me too far to attempt to pass in review the various theories of the pre-Darwinians—Treviranus, De Maillet, Goethe, Buffon, Geoffroy St. Hilaire, Erasmus Darwin, and the anonymous author of the *Vestiges of Creation*. This task has been admirably performed by Professor Haeckel in his *History of Creation*, and in the later editions of the *Origin of Species* Mr. Darwin has collected quite a number of sporadic adumbrations not only of the law of evolution itself but even of that of natural selection. I shall be obliged to confine myself almost exclusively to the one great mind, who, far more than all others combined, paved the way for the new science of biology to be founded by Darwin, namely, Lamarck. His life was chiefly devoted to the systematic and structural investigation of animals and plants and his earlier works gave little indication of philosophical tendencies, but his *Philosophie*

Zoologique,* which appeared in 1809, showed that he had reasoned deeply about the objects he had so long studied, and in this work is contained the whole of his celebrated system of the transmutation of species.

LAMARCKISM.

Although most of the members of this Society are doubtless familiar with the general character of the Lamarckian philosophy, and many have probably read this work, the nature of my subject seems to demand that some of the more general principles of Lamarckism be set forth. A few paragraphs from the work in question will accomplish this better than an attempt at exposition. The following quotations will serve to show the sweeping character of Lamarck's generalizations, and when we remember the time at which they were written it will not appear strange that his views attracted so few adherents and had to wait half a century for a respectful hearing.

"In order to judge," says Lamarck, "whether the idea that has been formed of a *species* has any real foundation, let us return to the considerations which I have already set forth; they show:

1st. That all the organized bodies of our globe are true products of Nature, which she has successively brought forth (*exécutés*) in the course of long periods of time;

2d. That in her march Nature has commenced, and is still daily commencing to form the most simple organized bodies, and that she only forms these latter directly, that is, only these first sketches of organization that have been designated by the expression *spontaneous generation*;

3d. That these first outlines of the animal and of the plant formed at suitable places and under appropriate circumstances, and possessing the attributes of incipient life and organic movement, have themselves little by little developed organs and in time multiplied these as well as parts;

4th. That the power of growth in each part of the organized body being inherent in the first effects of life, it has given rise to the different modes of multiplication and reproduction of individuals, and that in this way the progress acquired in organization and in the form and diversity of parts has been preserved;

5th. That by the aid of sufficient time, of circumstances which have been necessarily favorable, of the changes which all points on the surface of the globe have successively undergone in their condition, in a word, by the power which new situations and new habits possess to modify the organs of bodies and of life, all the organisms that now exist have been insensibly formed such as we see them;

6th. Finally, that under the influence of such an order of things, living bodies having undergone each of the changes, greater or less, in their structure and in their parts, what is called *species* thus insensibly and successively brought about among them has only a relative constancy in its character and cannot be as ancient as Nature herself."†

* Philosophie Zoologique, etc. Par Jean-Baptiste-Pierre-Antoine de Monet, Chevalier de Lamarck. Nouvelle Edition, revue et précédée d'une introduction biographique par Charles Martins. Paris, 1873, 2 vols. 8°.

† Op. cit., Vol. I, pp. 81-83.

It will be seen that both the mutability and the transmutation of species are distinctly formulated. But in order to make this more clear he elsewhere says:

"In the same climate very different situations and exposures cause individuals thus placed at first simply to vary; but in the course of time the continual differences of situation of the individuals of which I speak, living and reproducing under the same conditions, bring about in them differences which become in some sort essential to their existence, so that at the end of many generations which succeed each other those individuals which belonged originally to another species find themselves transformed into a new species, distinct from the other."*

The two great causes to which he ascribes this transformation are: (1) what he calls the "circumstances," and (2) the "habits of the creatures transformed, and to enforce this idea he lays down the following "zoological principle" the fundamental truth of which, he says, appears to him incontestable:

"Progress in the structure (*composition*) of the organization undergoes here and there in the general series of animals anomalies brought about by the character of the habitat (*circonstances d'habitation*), and by that of habits contracted."†

Between the "circumstances" and the "habits," however, Lamarck perceived a causal relation, and this he expressed in the following argumentative form:

"The true order of things to be considered in all this consists in recognizing:

1st. That every permanent change of any consequence in the circumstances under which each race of animals finds itself effects within it a real change in their needs;

2d. That every change in the needs of animals necessitates for them other actions to satisfy the new needs, and hence, other habits;

3d. That every new need necessitating new actions to satisfy it requires of the animal experiencing it either the more frequent employment of such of its organs of which it previously made less use, which develops and enlarges considerably, or else the employment of new parts to which the needs insensibly give rise within it through efforts of its internal sense."‡

In all this Lamarck does not expressly say that these transformations are perpetuated by heredity, although this is clearly implied, otherwise they would not be permanent. But he now proceeds to embody the general principle in what he calls a *law*, the first law of organic life, to which he adds a second law in which the principle of heredity is distinctly formulated. Although these two great Lamarckian laws have been frequently quoted in biological discussions, especially within the past three or four years, it seems essential to the completeness of the present exposition to introduce them. They are as follows:

First Law: "In every animal which has not passed the limit of its development the more frequent and sustained exercise (*emploi*) of any organ gradually

* Op. cit., Vol. I, pp. 79-80.

† *Ibid.*, p. 145.

‡ *Ibid.* pp. 234-235.

strengthens that organ, develops and enlarges it, and gives it a power proportioned to the duration of such exercise; while the continued lack of exercise (*usage*) of an organ gradually enfeebles it, deteriorates it, progressively diminishes its power, and finally causes it to disappear."

Second Law: "All that nature has caused individuals to acquire or to lose through the influence of the circumstances to which their race has found itself for a long time exposed, and consequently, through the predominant exercise of certain organs, or through a failure to exercise certain parts, it preserves through heredity (*génération*) to the new individuals that are produced by them, provided the changes acquired are common to the two sexes, or to those that have produced these new individuals."*

These laws are enforced by considerable iteration and all the facts and illustrations that he could command. He condenses his first law into the following form:

"The frequent exercise of an organ which through habit has become permanent increases the capacity of such organ, develops it, and causes it to acquire dimensions and power of action which it does not possess in animals that exercise it less."†

The second law is re-stated in the following language:

"Every change acquired in an organ by an habitual exercise sufficient to have brought it about, is preserved thereafter through heredity (*génération*) if it is common to the individuals which, in fecundation, unite in the reproduction of their species."‡

Such is Lamarckism pure and simple, which it seemed necessary to set forth at first hand before approaching those modern phases of the problem which have grown out of it. It is obvious that it deals only with the first of the two agencies in biologic progress mentioned at the outset, namely the functional; and Lamarck, although he clearly grasped the law of competition, or the struggle for existence, the law of adaptation, or the correspondence of the organism to the changing environment, the transmutation of species, and the genealogical descent of all organic beings, the more complex from the more simple; he nevertheless failed to conceive the selective principle as formulated by Darwin and Wallace, which so admirably complemented these great laws.

The cogeny of Lamarck's reasoning, especially when we consider the time at which he wrote, is sufficiently apparent to all, but it may not be without interest to note the manner in which it struck so excellent a judge as Professor Huxley as late as 1876. In contrasting it with the views of Cuvier who maintained the fixity of species and their special creation, Professor Huxley says:

"It is impossible to read the 'Discours sur les Révolutions' of Cuvier, and the 'Principes' of Lamarck without being struck with the superiority of the

* Op. cit., Vol. I, pp. 235-236.

† *Ibid.*, p. 247.

‡ *Ibid.*, pp. 258-259.

former in sobriety of thought, precision of statement, and coolness of judgment. But it is no less impossible to consider the present state of biological science without being impressed by the circumstance that it is the conception of Lamarck which has triumphed and that of Cuvier which has been vanquished. . . . It is not too much to say that the facts of biology known at the present day are all consistent with and in favor of the view of species entertained by Lamarck, while they are unfavorable to, if not incompatible with, that advocated by Cuvier.”*

DARWINISM.

Darwin was acquainted with Lamarck's views when he wrote the *Origin of Species*, and notwithstanding the fact that whenever he refers to Lamarck, as he does in several of his letters† he does so in a very disparaging way, he must have been greatly influenced by them, or at least by views of the same import expressed by others as well as by Lamarck, but especially those of his grandfather Erasmus Darwin, who anticipated, rather from the standpoint of the poet and seer, the truths to which Lamarck was led by a life-long study of living things.

But Darwin, like most other thorough naturalists, was little satisfied with the Lamarckian theory, because it left, as all now admit, so much still unexplained, but instead of rejecting it in toto, as most other naturalists did, he sought, and happily succeeded in finding the principle on which the remainder of the facts could be accounted for; or, at least, the greater part of them, for it seems that however deeply we may probe the secrets of nature there will ever remain a few residual phenomena that refuse to submit to our canons.

It is certainly unnecessary that I should occupy your time with any extended exposition of the law of selection, and I will content myself with the following bare definitions:

Natural selection is the general law that variations are constantly occurring in organized beings, and that such of these variations as prove advantageous to the species are preserved through heredity and transmitted to posterity while those which are not advantageous or are disadvantageous to the species are not preserved nor transmitted; the cause of such selection being the fact that advantageous variations tend to increase the chances that the individuals possessing them will reach the reproductive age and continue longer to reproduce, and will hence leave a larger number of offspring than those individuals which had not varied or had varied in an equivocal or unfavorable manner.

Artificial selection is the act of man in intelligently selecting the individuals that possess in the highest degree the particular qualities that he desires to produce as the parents of the animals or plants which he wishes to domesticate or cultivate. The eminent success obtained by man in this way is the certain

* *Am. Cycl.*, Art. *Species*.

† *Life and Letters*, Vol. I, p. 542, Vol. II, p. 198.

proof that the qualities of the parents are transmitted to their offspring, and explains the efficacy of natural selection.

Sexual selection is the law that one sex, usually the female, exercises a choice between the individuals of the other, whereby those individuals possessing the selected qualities stand a much greater chance to have the opportunity of transmitting them to their offspring. This law explains the greater ornamentation of the males in so many species, since most such characters are peculiar to one sex and only appear at maturity. Sexual selection also checks the tendency of natural selection to extreme variation in certain directions, since the sexes are well known to prefer their opposites, which causes the offspring to occupy a mean between the extremes. This effect is very marked in the human race, but is doubtless operative among the lower animals. As I pointed out in last year's address, sexual selection has wrought a great revolution in the relative size, strength, and beauty of the two sexes, and reversed in birds and mammals the normal law of female superiority which prevails in most of the lower departments of life.

ACQUIRED CHARACTERS.

It will be readily perceived from what has been said of the two great principles of transformism, the functional, as set forth by Lamarck, and the selective, as elaborated by Darwin, that the fundamental distinction between them is that in the former the transforming qualities which are to be cumulatively transmitted through heredity to the descendants of a given ancestral pair are acquired during the lifetime of these individuals, whereas in the latter the transforming increment is a merely accidental modification arising from unknown causes and hence called spontaneous. The theory is that such spontaneous variations are constantly taking place in all individuals, some in one direction and some in another, and that all except the advantageous ones are immediately lost, while such as tend to increase the chances of survival in the struggle for existence are preserved. Nature has thus provided, through this survival of the fittest, for the maintenance of the equilibrium between the organism and the environment, and also for the increase of structural adaptation and vital power, independently both of the effort of the individual to conform more exactly to its surroundings and of the reaction of the organism upon the impinging environment.

There has never been any doubt of the perfect transmissibility of these spontaneous modifications, or, as they have been called, fortuitous variations. They belong to the essential nature of the organism, and have, as we shall see later on, been ingeniously explained as originating in the very germ itself.

But with regard to functional modifications, or as they are more commonly called, acquired characters, grave doubts have arisen in the minds of many naturalists as to whether they are capable of being inherited by the descendants of those in which they have been superinduced. They are in a certain sense foreign to the organism, external and superficial, and the great question has been how they can succeed in so affecting the reproductive germs of the parents as to reappear in the offspring. That Darwin believed in the transmission of functionally acquired characters is attested not only by many passages in which this belief is expressly stated but by the bringing together by him of more facts in support of it than have been given by all other writers combined either before or since. And although the greater part of his work was naturally directed to the establishment of the hitherto unknown, but as he believed, more important law of selection, nevertheless Darwinism proper must be made broad enough to embrace both of the great agencies of organic transformation, the functional and the selective.

It is hardly necessary to add that pure Lamarckism has nothing whatever to do with such a question as whether accidental modifications produced upon an organism, such as mutilations from whatever cause, are inheritable, since these are not due to continuous interaction between organism and environment, are not the objects of the creature's efforts, and are not acquired by any functional or habitual activities. And yet it is no exaggeration to say that at least one-half, probably much more, of the space devoted by the Neo-Darwinians to the supposed refutation of Lamarckism has been directed to proving that accidental mutilations are not transmitted to offspring.

I do not deny that there is a doctrine of the transmissibility of mutilations, and Darwin and others have collected a large body of facts pointing strongly in that direction, while Brown Séquard is believed by many to have demonstrated that hereditary epilepsy may be artificially superinduced in guinea-pigs by lesions of the brain. And it may be that Lamarck, coming upon similar facts, gave them a certain credence, but, as we have seen from typical passages quoted from his work, these cases are not capable of being used in support of his general philosophy, which rests entirely upon the effects of functional activities exerted in response to secular alterations in the surrounding conditions of existence.

Whatever of truth, therefore, there may be in the doctrine of the transmissibility of suddenly or accidentally acquired characters, it is clearly outside the present discussion and need not be further touched upon.

After the doctrine of natural selection had been clearly explained it was found to be so simple and at the same time so far-reaching that it began to be questioned whether much that

had been formerly attributed to the other agency ought not to be credited to it instead; and it cannot be denied that this inquiry tended to broaden the field of the selective at the expense of that of the functional principle. So clear and certain are the workings of the former that it is considered safe to credit it with every fact that can be explained by it, even though it be also explicable by the other law.

But it was not allowed to rest here. The difficulties in the way of accounting for the transmission of qualities originating after the birth of the parents appeared to some so great that they began to doubt whether in fact such a thing is really possible. Of course, there were many popular and superficial writers on evolution who failed to distinguish the two principles and talked as though all development was due to natural selection, so that to the unscientific and popular mind evolution and natural selection were largely synonymous and vaguely comprehended, as is, in fact, still, to a large extent, the case. Other better informed people, including some naturalists of note, were so dazzled by the new idea that they lost sight of the old one, and habitually ignored the functional element without criticising it or taking any account of it. It appears to have been against this class that Mr. Herbert Spencer's brilliant exposition of the principle which, in characteristic language, he calls "direct equilibration" was directed. To this I shall have occasion to revert.

For the present I propose to confine myself to those writers who clearly comprehend the nature of the two principles, and who either gravely doubt for what seem to them sufficient reasons, or else deny altogether the efficacy of functional modification and the doctrine of the transmission of acquired characters. The limits of an address such as this preclude any effort to make the discussion historically exhaustive by enumerating all the investigators who from the first to last have taken this view, or some modified form of it, and I shall be content to name among Germans Du Bois Reymond, Pflüger, His, and Weismann, and among Englishmen Galton, Wallace, and Ray Lankester; while what I shall have time to say relative to the nature of the objections raised by these authors will be chiefly confined, for the present, to the views of Galton and Weismann.

THEORIES OF HEREDITY.

It must, however, be premised that inasmuch as the objections raised against the doctrine of the transmission of acquired characters are based upon the difficulties encountered in attempting to explain how such characters can impress themselves upon the germ, all those who have doubted or denied such transmission have approached the subject from the side of

embryology, which makes their arguments difficult to explain to biologists in general and still more so to the general public. The laws and processes of heredity are still in the stage of mystery, and their mysterious character has led to many erroneous beliefs and popular superstitions. It is a significant fact that all the mysteries that have been thus far cleared up by science—astronomical, physical and chemical mysteries—have been shown to be the expressions of previously unknown laws of matter and force, and to rest upon a purely material and mechanical basis. The chief obstacle to their comprehension has been the minuteness of the material elements in action—a minuteness far beyond the capacity of the most powerful artificial aids to the senses—so that their secrets have had to be wrung from them by ingenious and multiplied experiments upon their effects. Now, the ultimate reproductive elements, though doubtless many times larger than any chemical molecule, even the most complex, such as those of protein and other organic compounds, are doubtless still far too minute to be observed by the highest powers of the microscope, and if the entire history of the formation of a new organic being is ever to be learned it must be by a successful study of the actions of such minute objects. But this is infinitely more difficult than the study of the actions of inorganic elements, since they take place within an organism whose destruction destroys their vital character.

In view of the history of the less complex sciences it is natural that biologists should insist that the phenomena of heredity are due to the activities of the ultimate material reproductive elements, and not to any vague and occult force or *deus ex machina*. Consequently we find that the only theories of heredity that have been put forth have been based on this assumption.

One of the earliest, and certainly the most celebrated of such theories is Darwin's *pangenesis*, published in 1867.* According to this theory, which is doubtless familiar to most of you, the ultimate reproductive elements, called *gemmules*, are given off from the cells of all parts of the body and collect in the germ-cells and sperm-cells, so that the fertilized ova contain literal representatives of every organ and every part of both parents, which in the new being return to their respective locations and cause the repetition in each of the exact qualities possessed by the parental organs or parts, subject, of course, to the modifications due to a conflict or coöperation between the *gemmules* of the two parents, equalizing a character where they are different, and emphasizing it where they are alike.

It will be readily seen that this theory adapts itself to the

* Variations of Animals and Plants under Domestication. Vol. II, Chaps. XXXVII, XXXVIII.

broadest conception of heredity and, if true, accounts for the transmission of functionally produced modifications as well as the selection of such accidental ones as prove advantageous. But to the ordinary mind this strictly materialistic explanation of heredity seems crude and is to a large extent unintelligible, and the doctrine of pangenesis has gained few adherents among scientific men. They fail as a rule to comprehend Mr. Darwin's gemmules and to understand how they should behave in the manner required by the theory.

Very much of this difficulty, however, is cleared away by the admirable exposition of Mr. Herbert Spencer of the nature of what he calls physiological units. To the biologists the organic unit is the cell and when he has explained the nature and action of cells he thinks he has gone far enough. But the facts of heredity cannot be explained by any phenomena manifested by cells. Between the cell or morphological unit in biology and the molecule of a highly complex organic compound, such as albumen,—the highest class of chemical units—no intermediate element had hitherto been recognized. Mr. Darwin's gemmule is clearly such an intermediate element, and the question at once arose, is there any such? Mr. Spencer has, I think, shown beyond the possibility of doubt that there is and must necessarily be such an element—a unit which is not chemical, since it possesses life, and which is not the morphological unit or cell, but is that of which the active part of every cell consists, and is appropriately termed the physiological unit. I have elsewhere* undertaken to show that life may have resulted from a process of chemical recombining, and may actually constitute the leading property of the highest organic compound protoplasm, and I venture to suggest here that the gemmules of Darwin and the physiological units of Spencer may be nothing more than the molecules of protoplasm, which, as I have explained, are so immensely complex that any required degree of difference in their essential constitution may easily exist.

The only other theory of heredity which time will warrant my mentioning now is that of Professor Haeckel, published in 1876 and known as "the perigenesis of the plastidule." To avoid the possibility of misstatement, I will give this theory in the words of its author, as epitomized in the latest (8th) edition (1889) of his *Schöpfungsgeschichte* (pp. 200–201):

"The perigenesis-theory was founded by me in 1876 in a memoir 'on the wave-reproduction of vital particles or the perigenesis of plastidules,' and as a 'provisional attempt at a mechanical explanation of the elementary processes of development,' and especially of heredity. (In the second part of my collec-

* *American Naturalist*, Vol. XVI, December, 1882, p. 976. *Dynamic Sociology*, New York, 1883, Vol. I, p. 311.

tion of popular lectures, Bonn, 1879, pp. 25-80). The perigenesis-hypothesis seeks to explain heredity by a simple mechanical principle, namely, by the well-known principle of transmitted motion. I assume that in every process of reproduction not only is the special chemical composition of the plasson or plasma transmitted from the parent to the offspring, but also the special form of molecular motion which belongs to its physico-chemical nature. In harmony with the fundamental laws of modern histology and histogeny, I assume that this plasma (either the caryo-plasma of the cell-nucleus or the cytoplasma of the cell-body) is alone the original bearer of all vital activity, and hence also of heredity and reproduction. In all plastids (as well the anucleated cytodemes as the genuine nucleated cells) this plasma or plasson is composed of plastidules or plasma-molecules, and these are 'probably surrounded by aqueous envelops; the greater or less thickness of these aqueous envelops, which at once separate and bind the neighboring plastidules, determines the softer or harder condition of the flowing plasson' (p. 48).

"Heredity is the transmission of plastidule motion, whereas adaptation is change of plastidule motion' (p. 55). This motion may in its general aspects be conceived as a ramified wave motion. In all protists or unicellular organisms (protophytes and protozoans) this periodical movement of the mass goes on in a correspondingly simple manner while in all tissue-bearing or multicellular creatures (metaphytes and metazoans) it is combined with a mutual generation of the plastids and a division of labor of the plastidules."

It will be observed that although this theory of heredity lays special stress upon the idea of motion, thereby recognizing the element of force, it is nevertheless based like all others upon the existence of ultimate material elements different on the one hand from the chemical molecules and on the other from cells, and intermediate between these. The gemmule of Darwin, the physiological unit of Spencer, and the plastidule of Haeckel are the same in essence, and the study of the phenomena of these ultimate elements of biology opens up a new and most promising field of research into which scarcely any investigator has as yet deliberately entered.

We are now prepared to consider the objections of Galton and Weismann to the doctrine of the transmission of functionally acquired characters.

VIEWES OF MR. GALTON.

The earliest expression of Mr. Galton's views, so far as I am aware, is contained in a paper "On Blood-Relationship" presented by him on June 13, 1872, to the Royal Society of London and published in its proceedings.* In this paper stress is laid upon the distinction in embryonic development between what he calls the "patent" and the "latent" elements, and he argues from the facts of reversion and atavism that the greater part of the parental elements in heredity are latent in the germ, but prepared to express themselves in more or less remote descendants. Although he addresses himself to the anthropologist rather than the biologist, and[†] claims only to be making a contri-

* Vol. XX, p. 394.

bution to the difficult subject of kinship, he nevertheless evinces a clear grasp of the embryonic conditions of the problem, and as we shall see, anticipates, some of the more exact conceptions of Weismann. He does not wholly deny the possibility of the transmission of acquired characters, but says that "the effects of use and disuse of limbs, and those of habit, are transmitted to posterity in only a very slight degree."

In this respect Mr. Galton makes only a slight advance toward the conclusions of Weismann in the much more elaborate paper which he read before the Anthropological Institute of Great Britain on November 9, 1875, and which appeared in the December number of the Contemporary Review for that year, and also in an expanded form in the Journal of the Institute (Vol. V, p. 329). In this paper which is entitled "A Theory of Heredity," he, however, approaches the main question with much greater directness.

"The facts," he says, "for which a complete theory of heredity must account may conveniently be divided into two groups; the one refers to those inborn or congenital peculiarities that were also congenital in one or more ancestors, the other to those that were not congenital in the ancestors, but were acquired for the first time by one or more of them during their lifetime, owing to some change in the conditions of their life. The first of these two groups is of predominant importance, in respect to the number of well-ascertained facts that it contains, many of which it is possible to explain in a broad and general way, by more than one theory based on the hypothesis of organic units. The second group includes much of which the evidence is questionable or difficult of verification and which, as I shall endeavor to show, does not for the most part, justify the conclusion commonly derived from it."

He further says that his theory

"is largely based on the arguments and conditions brought forward by Mr. Darwin in support of pangenesis; nevertheless the conclusions in this paper will be seen to differ essentially from his own. Pangenesis appears more especially framed to account for the cases which fall in the second of the above-mentioned groups which are of a less striking and assured character than those of the first group, and it will be seen that I accept the theory of pangenesis with considerable modification, as a supplementary and subordinate part of a complete theory of heredity, but by no means for the primary and more important part."

He employs the term *stirp* "in a special sense—to express the sum-total of the germs, gemmules, or whatever they may be called, which are to be found, according to every theory of organic units, in the newly fertilized ovum—that is in its earliest pre-embryonic stage." In defending the theory of organic units he says: "We must bear in mind that the alternative hypothesis of a general plastic force resembles that of other mystic conceptions current in the early stages of many branches of physical science, all of which yielded to molecular views, as knowledge increased."

The paper is an exceedingly luminous contribution to the subject, and the theory advanced may be designated in general terms as the doctrine of natural selection or survival of the fittest among the organic units constituting the stirp, to determine which shall become manifest in the offspring and which shall lie latent to reappear or not in later generations. As the stirp contains organic units that have lain latent in previous generations and may become patent in the generation in question, the theory accounts for reversion, atavism, and the whole train of facts in heredity that have so long puzzled the scientific investigator. We are at present only concerned with so much of it as relates to the transmission of acquired characters. The following passage expresses his views on this point:

"We have thus far dealt with three agents—(1) the stirp, which is an organized aggregate of a host of germs; (2) the personal structure, developed out of a small portion of these germs; and (3) the sexual elements, generated by the residuum of the stirp. The cases before us are those which are supposed to prove that 2 reacts on 3—that is, the personal structure upon the sexual elements. The first and largest class of these cases refers to adaptivity of race. It is said that the structure of an animal changes when he is placed under changed conditions; that his offspring inherit some of his change; and that they vary still further on their own account, in the same direction, and so on through successive generations, until a notable change in the congenital characteristics of the race has been effected. Hence it is concluded that a change in the personal structure has reacted on the sexual elements. For my part, I object to so general a conclusion."

And he proceeds to elaborate his reasons for such objection. Passing over these for want of time I will conclude this exposition of Galton's views by quoting the following passage:

"The conclusion to be drawn from the foregoing arguments is, that we might almost reserve our belief that the structural cells can react on the sexual elements at all, and we may be confident that at the most they do so in a very faint degree; in other words that acquired modifications are barely, if at all, *inherited*, in the correct sense of that word. If they were not heritable, then the second group of cases would vanish, and we should be absolved from all further trouble about them; but if they exist, in however faint a degree, a complete theory of heredity must account for them. I propose, as already stated, to accept the supposition of their being faintly heritable, and to account for them by a modification of pangenesis."

I am not aware that Mr. Galton has modified the views here expressed since the date of that paper, but in all his subsequent ones, as well as in his work on "Hereditary Genius" (1879) he continues to emphasize the paramount importance of the latent elements in heredity, and the superiority, as he forcibly expresses it, of nature over nurture.

TEACHINGS OF PROFESSOR WEISMANN.

The vigorous onslaught which has been made upon the doctrine of the transmission of acquired characters, since the date

of Mr. Galton's papers, and apparently without a knowledge of them, by Prof. August Weismann of the University of Freiburg has probably aroused a greater amount of interest among scientific men than any other event that has transpired since the appearance of Darwin's *Origin of Species*. Professor Weismann is an embryologist and histologist and has conducted a series of prolonged and successful investigations upon several groups of lowly organisms. But he has looked beyond the special facts which are immediately connected with his researches and has thought out for himself all the deeper problems of biology. Besides making himself complete master of the whole field of that science as generally accepted he has co-ordinated its facts and drawn from them a number of new and brilliant conclusions which have set the world to work on entirely new lines of investigation.

Professor Weismann was logically led to the conclusion that acquired characters cannot in any conceivable way be transmitted. The first of the series of essays which have produced such a sensation, that on the duration of life, was originally read before the Association of German Naturalists and Physicians at Salzburg in September, 1881, and a short abstract of it appeared in *Nature* for April 5, 1888 (Vol. XXXVII, p. 541). It was in this paper that he elaborated the theory that unicellular organisms are potentially immortal. The second of the series, that on heredity, was his inaugural address as Pro-rector of the University of Freiburg, delivered June 21, 1883. It was in this that he first attacked the doctrine of the transmission of acquired characters, and in it and the preceding essay may be found the germs of all his later theories. The remaining six essays appeared at intervals from 1883 to 1888. Abstracts and reviews of them occurred in *Nature* and the English magazines, and long before the appearance in 1889 of the admirable work containing an English translation of the whole series with numerous additions and amendments by the author and notes by the translators,* the controversy had begun in which so many of the most eminent biologists of Europe and America have taken part.

Professor Weismann's general course of reasoning is somewhat as follows: It is universally admitted that all the higher organisms consist of tissues made up of cells and that these cells do not differ essentially from those which are found leading an independent existence and are termed unicellular organisms. Many of these unicellular organisms reproduce by the process known as fission or division; that is, they split or

* Essays upon Heredity and kindred biological problems. By August Weismann. Authorized translation edited by Edward B. Poulton, Selmar Schönland, and Arthur E. Shipley. Oxford, Clarendon Press, 1889.

divide into two equal parts each of which becomes a new organism exactly like the original. These halves exist for an appointed time, increase in size until they are each equal to the original cell before division, and then divide again, so that what was formerly one now becomes four. Each of these four repeats the process, and so on, thus multiplying in a geometrical ratio. But if we follow any one of these lines of descent we observe that the last of the line contains some of the same matter that was in the first, and none of the matter has ceased to live. Unless destroyed by some external cause all of the substance of the original cell will continue to live for any conceivable length of time. It is "potentially immortal." Now, the theory of descent as a universal organic principle, which Weismann fully accepts, explains all the life of the globe as resulting from previous life through some form of reproduction. Fission is the simplest form of reproduction, and it is found that it is the common form of cell-reproduction within the tissues of the higher animals. All growth is brought about by it or some modification of it. A study of the phenomena of reproduction in the lower organisms shows that it takes place ultimately through some similar process, which, however greatly modified in its details, consists essentially in the actual transmission of the reproductive cell-substance from parent to offspring, and Weismann maintains that the reproductive cells, like those of unicellular organisms, are immortal or perpetual, and that nothing can get into the body of the offspring except through that of one or other of its parents. This is his fundamental doctrine of the continuity of the germ-plasm. The impregnated ovum contains the germ-plasms of the two parents, and out of it the embryo is formed. The embryo develops independently of the mother by a circulation of its own, and no external influences can by any conceivable method affect or change the characters of the offspring.

But it is well known that variation takes place, that the offspring does not always resemble either parent, and that changes go on so great as to result in the creation of new species, new genera, and entirely new types of life. All this Weismann admits. How does he explain it? Primarily by natural selection, but he does not stop with that. It has always been admitted that natural selection did not explain the cause of variation. Weismann attempts to do this, and his reasoning is exceedingly ingenious.

The original reproductive cells are assumed by him to consist of an indefinite number of units which he calls germ-plasms, and their presence is explained on the assumption of their preservation from ancestral organisms. Asexual reproduction is of course incapable of producing variation, and he maintains that sexual reproduction has been developed and exists solely for the purpose of insuring variation.

Relative to the constitution of the germ-plasm he says:

"Every detail in the whole organism must be represented in the germ-plasm by its own special and peculiar arrangement of the groups of molecules (micellæ of Nägeli) and the germ-plasm not only contains the whole of the quantitative and qualitative characters of the species, but also all individual variations as far as these are hereditary: for example the small depression in the center of the chin noticed in some families. The physical causes of all apparently unimportant hereditary habits or structures, of hereditary talents, and other mental peculiarities, must all be contained in the minute quantity of germ-plasm which is possessed by the nucleus of a germ-cell; not indeed, as the preformed germs of structure (the gemmules of pangenesis), but as variations in its molecular constitution; if this be impossible, such characters could not be inherited" (pp. 100-101).

The union of two germ-cells from entirely different individuals always multiplies the number of ancestral germ-plasms by two. The excess is kept down by the removal of the second polar body, as he supposed was proved by its not taking place in parthenogenesis. But the part removed as well as the part retained contains germ-plasms from both parents alike and hence the offspring must partake of the nature of both.

These ancestral germ-plasms exist in the reproductive cells in vast numbers, and in the removal of half of them at each union of the sexes, there must remain not merely those of the immediate parents, but those of previous generations. If we were theoretically to conceive that at the outset only a single germ-plasm existed from each parent, then the second generation would transmit four, the third eight, and so on in a geometrical ratio, until they would become so numerous as to require the removal of a portion and ultimately always of half the ancestral germ-plasms at each act of reproduction. Says Professor Weismann:

"These different qualities are what I have called the ancestral germ-plasms, i. e., the germ-plasms of the different ancestors, which must be contained in vast numbers, but in very minute quantities, in the nuclear thread. The supposition of a vast number is not only required by the phenomena of heredity but also results from the comparatively great length of the nuclear thread; furthermore it implies that each of them is present in very small quantity. The vast number together with the minute quantity of the ancestral germ-plasms permit us to conclude that they are, upon the whole, arranged in a linear manner in the thin threadlike loops; in fact the longitudinal splitting of these loops appears to me to be almost a proof of the existence of such an arrangement, for without this supposition the process would cease to have any meaning" (pp. 359-360).

His general view of the origin of variation is thus given by him:

"It is well known that this process [sexual or amphigonic reproduction] consists in the coalescence of two distinct germ-cells, or perhaps only of their nuclei. These germ-cells contain the germ-substance, the germ-plasm, and this again, owing to its specific molecular structure, is the bearer of the hereditary tendencies of the organism from which the germ-cell has been derived.

Thus in amphigonic reproduction two groups of hereditary tendencies are as it were combined. I regard this combination as the cause of hereditary individual characters, and I believe that the production of such characters is the true significance of amphigonic reproduction. The object of this process is to create those individual differences which form the material out of which natural selection produces new species" (p. 272). "I do not know what meaning can be attributed to sexual reproduction other than the creation of hereditary individual characters to form the material upon which natural selection may work" (p. 281). "The most important duty of sexual reproduction is to preserve and continually call forth individual variability, the foundation upon which the transformation of species is built" (p. 373). "Sexual reproduction is to be explained as an arrangement which ensures an ever-varying supply of individual differences" (p. 384).

Weismann's classification of cells into somatic and reproductive is fundamental to his whole philosophy. On this point he says:

"The first multicellular organism was probably a cluster of similar cells, but these units soon lost their original homogeneity. As the result of mere relative position, some of the cells were especially fitted to provide for the nutrition of the colony, while others undertook the work of reproduction. Hence the single group would come to be divided into two groups of cells, which may be called somatic and reproductive—the cells of the body as opposed to those which are concerned with reproduction (p. 27). . . . As the complexity of the metazoan body increased, the two groups of cells became more sharply separated from each other. Very soon the somatic cells surpassed the reproductive in number, and during the increase they became more and more broken up by the principle of the division of labor into sharply separated systems of tissues. As these changes took place the power of reproducing large parts of the organism was lost, while the power of reproducing the whole individual became concentrated in the reproductive cells alone" (p. 28).

His theory further assumes that the germ-cells contain two kinds of plasm, which he calls respectively the *ovogenetic* and the *somatogenic*, i. e., the first capable only of producing germ-cells, the latter capable only of producing somatic cells. These exist together in the fertilized ovum, and if allowed to remain there would go on reproducing themselves in something like equal numbers. But the body consisting almost entirely of somatic cells, it is evident that such a multiplication of germ-cells would be only a hindrance to development. This, he claims, explains the mysterious phenomena so long observed by embryologists and called the removal of polar bodies. The polar body first removed is nothing more nor less than the ovogenetic nucleo-plasm, which is now in the way, and whose removal is necessary to the formation of the embryo. This is the work alone of the somatic cells, and these, consisting as they do of the germ-plasms of an indefinite series of ancestors, and containing representatives of every part of the parent organism, proceed to reproduce a new creature on the hereditary type of the parents with the modifications due to the commingling of many ancestral types.

Without dwelling longer upon these ultimate processes

which constitute the premises of Weismann's argument, I will now proceed to state his conclusion. It is simply that he is utterly unable to see how the somatic cells of an adult individual can react upon or in any way affect its reproductive cells. If it cannot, the transmission through either parent to its offspring of any peculiarity acquired since the embryo of the parent began to form is impossible. Firmly believing in the truth of his theory he stoutly insists that no such thing can take place. Of course it needs to be clearly understood what he means by acquired characters, and here, it is claimed, lies the chief point in dispute between the Neo-Darwinians and the Neo-Lamarckians. The former contend that the latter class as acquired characters those which are simply due to natural selection. It will therefore be profitable to dwell a moment upon this point.

"The tendencies of heredity," says Weismann, "of which the germ-plasm is the bearer, depend upon this very molecular structure, and hence only those characters can be transmitted through successive generations which have been previously inherited, viz., those characters which were potentially contained in the structure of the germ-plasm. It also follows that those other characters which have been acquired by the influence of special external conditions, during the lifetime of the parent, cannot be transmitted at all" (p. 267). "It is only by supposing that these changes arose from molecular alterations in the reproductive cell that we can understand how the reproductive cells of the next generation can originate the same changes in the cells which are developed from them; and it is impossible to imagine any way in which the transmission of changes produced by the direct action of external forces upon the somatic cells, can be brought about. . . . To this class of phenomena of course belong those acts of will which call forth the functional activity of certain groups of cells" (p. 80). "Only those new characters can be called 'acquired' which owe their origin to external influences, and the term 'acquired' must be denied to those which wholly depend upon the mysterious relationship between the different hereditary tendencies which meet in the fertilized ovum. These latter are not 'acquired' but inherited, although the ancestors did not possess them as such, but only, as it were, the elements of which they are composed, (p. 252). "If acquired characters are bought forward in connexion with the question of the transformation of species, the term 'acquired' must only be applied to those characters which do not arise from within the organism, but which arise as the reaction of the organism under some external stimulus, most commonly as the consequence of the increased or diminished use of an organ or part" (p. 322).

That such characters cannot be inherited he asserts with the strongest emphasis and frequent iteration. His treatment of this point often borders on the dogmatic, as a few extracts will show.

"It has never been proved," he says, "that acquired characters are transmitted, and it has never been demonstrated, that, without the aid of such transmission, the evolution of the organic world becomes unintelligible. The inheritance of acquired characters has never been proved, either by means of direct observation or by experiment" (p. 81). "No single fact is known that really proves that acquired characters can be transmitted" (p. 267). "If acquired characters cannot be transmitted the Lamarckian theory completely collapses, and we must entirely abandon the principle on which alone Lamarck

sought to explain the transformation of species,—a principle of which the application has been greatly restricted by Darwin in the discovery of natural selection, but which was still to a large extent retained by him. Even the apparently powerful factors in transformation—the use and disuse of organs, the results of practice or neglect—cannot now be regarded as possessing any direct transforming influence upon a species, and the same is true of all the other direct influences, such as nutrition, light, moisture, and that combination of different influences which we call climate. All these, with use and disuse, may perhaps produce great effects upon the body (soma) of the individual, but cannot produce any effect in the transformation of the species, simply because they can never reach the germ-cells from which the succeeding generation arises” (pp. 387–388).

And much more in the same strain.

Weismann fully admits the influence of the environment upon the individual in producing marked changes. He also fully admits the facts of adaptation to environment and the transformation of species and development of organic beings. But he insists that natural selection is competent to explain all this, that it takes place through the selection of such accidental variations in the germ as prove advantageous, or, as he puts it, the selection from among an infinite number of ancestral germ-plasms in the fertilized ovum of such as will produce an individual most in harmony with its environment, leaving all others in the latent state. This, as we have seen, is pure Galtonism.

But this incapacity for the inheritance of acquired characters is confined to metazoans or multicellular organisms—organisms whose reproductive and somatic cells are differentiated. It does not apply to protozoans or unicellular organisms. These are greatly influenced by the environment, and, consisting entirely as it were of reproductive cells, naturally transmit their variations to their descendants directly. Only thus can variability be perpetuated, and whatever is true of them is true of all germ-cells.

“The origin of hereditary individual variability,” says Weismann, “cannot indeed be found in the higher organisms—the Metazoa and Metaphyta; but is to be sought for in the lowest—the unicellular organisms. In these latter the distinction between body-cell and germ-cell does not exist. Such organisms are reproduced by division, and if, therefore, any one of them becomes changed in the course of its life by some external influence, and thus receives an individual character, the method of reproduction ensures that the acquired peculiarity will be transmitted to its descendants” (pp. 277–278).

It is here that comes in his fundamental doctrine of the continuity of the germ-plasm. If not the germ-cells, at least the germ-plasm of either parent passes intact to the offspring. It is perpetual, or as he calls it, immortal. It gives to the new being its special character, but receives nothing from it. It remains in the offspring until it in turn becomes a parent, and again passes to the third generation without ever having ceased to live. Every living being on the globe to-day contains

in its germ-plasm something that has never ceased to live since the original life-breath was breathed into organic nature. Through all the ancestral types of the phyletic chain it has persisted, passing from parent to offspring through the transforming series, so that in the loins of the highest types of man there is something which was still living in the lowest primordial worm and even in the bathybian ooze of those primeval waters which in the earliest Cambrian times succeeded the formation of the original crust of the globe.

Upon this series of brilliant speculations and startling assertions, including much that it has been impossible for me to bring forward, has been founded the school of Neo-Darwinism. In Germany they attracted comparatively little attention, in France none, but in England they have become almost a shibboleth in the mouths of a large class of leading biologists.

It unfortunately requires something more than mere truth to arouse enthusiasm in many minds, and however much it may be disclaimed, it cannot probably be justly denied that the peculiar position of prominence and honor which this theory gives to the doctrine of natural selection, conceived and elaborated by Englishmen, had much to do with its especial charm for English ears. It is not to be supposed that Weismann deliberately bid for applause from England, but he could clearly see the tendency of his doctrines to exalt natural selection. He does not allude to this in any of his earlier essays, nor until he had begun to observe the effect his writings were producing in England. In the preface to his fifth essay, dated Nov. 22, 1885, however, he says:

"The transmission or non-transmission of acquired characters must be of the highest importance for a theory of heredity, and therefore for the true appreciation of the causes which lead to the transformation of species. Any one who believes, as I do, that acquired characters are not transmitted, will be compelled to assume that the process of natural selection has had a far larger share in the transformation of species than has been as yet accorded to it; for if such characters are not transmitted the modifying influence of external circumstances in many cases remains restricted to the individual, and cannot have any part in producing transformation" (pp. 252-253).

And in the last essay of this series, originally delivered in September, 1888, he further remarks:

"But if the transmission of acquired characters is truly impossible our theory of evolution must undergo material changes. We must completely abandon the Lamarckian principle, while the principle of Darwin and Wallace, viz., natural selection, will gain an immensely increased importance" (p. 423).

A CRITIQUE OF WEISMANN.

I have now, as I believe, fairly if not fully stated, chiefly in the language of its founder, the Neo-Darwinian theory, and

before passing to consider what has been said on the other side, and the position of the Neo-Lamarckians in general, I would like to pause a moment in order to offer a few reflections of my own upon Weismann's teachings. I am emboldened to do this the more not only because I have not seen the exact point of view from which they especially strike me touched upon by others in the voluminous discussion which has grown out of them, but also because what I shall say will be based entirely upon his own statement of the facts, and therefore the objection that, not being an embryologist, I am not competent to weigh the considerations from that side (which I would freely admit), cannot properly be raised.

The question is whether, accepting the continuity of the germ-plasm, accepting the nature which he ascribes to the fertilized ovum with its multitudes of ancestral plasms out of which selections are made, accepting his explanation of the meaning of the first and second polar bodies, accepting his differentiation into reproductive and somatic cells, and all the other details which he brings forward, many of which are, of course, only hypotheses, there do not still remain grounds on which to base a theory of the transmission of certain kinds of acquired characters, and especially those of a strictly functional nature. In fact, the question seems to me rather to be whether his line of argument carried to its extreme logical conclusion would not preclude the possibility of any variation whatever even in the germ-plasms themselves. It is not sufficient to say that all variation is due to the varied character of multitudinous germ-plasms in the fertilized ovum, brought there from many often remote ancestors possessing very different characters. This is a *petitio principii*, since it assumes these differences in those ancestors, and the primary question must be answered; whence these ancestral differences? How does he account for any differences at all?

We have already seen that Weismann restricts his denial to multicellular organisms and admits as a necessary part of his theory, that unicellular organisms are easily affected by the nature of their surroundings and activities, and that the changes thus produced are directly transmitted.

"If for instance," he says, "a protozoan, by constantly struggling against the mechanical influence of currents in water, were to gain a somewhat denser and more resistant protoplasm, or were to acquire the power of adhering more strongly than the other individuals of its species, the peculiarity in question would be directly continued on into its two descendants, for the latter are at first nothing more than the two halves of the former. It therefore follows that every modification which appears in the course of its life, every individual character, however it may have arisen, must necessarily be directly transmitted to the two offspring of a unicellular organism (p. 278). . . . We are thus driven to the conclusion that the ultimate origin of hereditary individual differences lies in the direct action of external influences upon the organism" (p. 279).

But he even goes further and asserts that there is no other way by which the germ can be affected.

"I have never doubted," he says, "about the transmission of changes which depend upon an alteration in the germ-plasm of the reproductive cells, for I have always asserted that these changes, and these alone must be transmitted (p. 410). . . . In what other way could the transformation of species be produced, if changes in the germ-plasm cannot be transmitted? And how could the germ-plasm be changed except by the operation of external influences, using the words in their widest sense?" (p. 411).

Now if, as he insists, external influences cannot possibly affect the germs of metazoans, and if, as he here maintains, it is external influence alone that can influence any germs, it must follow that the only variation that could have taken place in the germ-plasms of the highest animals are those which occurred in the protozoan stage of their development.

This is clearly a *reductio ad absurdum*, derived entirely from his own statements, some of them among his latest utterances. The difficulty is to see why he should adhere so tenaciously to the idea that the germ-cells cannot be influenced by functional changes in the organism containing them. The mere fact that they are lodged within the body of an animal does not affect the question unless it can be shown that they are so lodged that no change is possible in the nature of their immediate surroundings. To assume this is gratuitous and contrary to what would be naturally supposed. In reading certain passages in his own book one is strongly tempted to doubt whether he believes it himself. For example, he says in one place speaking of hereditary variations:

"I believe however that they can be referred to the various external influences to which the germ is exposed before the commencement of embryonic development. Hence we may fairly attribute to the adult organism influences which determine the phyletic development of its descendants. For the germ-cells are contained in the organism, and the external influences which affect them are intimately connected with the state of the organism in which they lie hid. . . . It is even possible that the effects of these influences may be more specialized; that is to say, that they may act only upon certain parts of the germ-cells" (pp. 103-104).

But he seems to see a great difference between this and the transmission of characters acquired in certain special organs to the same organs of the offspring. This would probably be clear only to an embryologist. One of the most suggestive thoughts in his whole philosophy is that of the total dissimilarity between the germ and the developed organism which is to result from it. He maintains with every semblance of truth that there can be nothing in common between them except the fact that the molecular structure of the germ is such that if allowed to develop it will produce a being similar to the one from which it sprung.

This principle seems to be peculiarly applicable to the subtle influences which affect heredity, and without appealing to anything occult or abandoning the strictly causal and mechanical theory of heredity, it may be submitted whether we know enough about it as yet to assert that influences affecting the parental organism, even any of its organs, may not react specifically and in kind upon the germ and set up molecular tendencies in the same direction. This may be said quite independently of any attempt to explain precisely how it can do so, as the theory of pangenesis claims to do.

If the germ-plasms vary within the body of either parent before they are brought together that variation must be due to influences acting upon them in the animal body. All this Weismann admits, but he denies that the changes which he admits to take place in the individual as the result of changes in the environment and subsequent changes in the habits and activities of the creature can be regarded as among the causes which produce changes in the germ-plasm. Is this logical or even reasonable? If not due to such changes to what causes are they due? Without pretending to explain how such a thing could happen, I claim that the indications are that it does happen. To say without proof that it cannot happen adds nothing to the argument. We have an antecedent and we have a consequent. Both are facts. There is no possibility in the present state of our knowledge of either proving or disproving the causal connection between these facts. Variation takes place in the direction of adaption to changed conditions and activities. So far the inference is confirmed by a third fact. If the inference had not been challenged in the interest of another principle this would be regarded as proof. I do not agree with Weismann that the burden of proof rests on those who draw this natural inference. It rests on him and the Neo-Darwinians to show that the assumed cause is not a cause. This they have thus far failed to do.

You will understand that I am speaking of variations which take place in the germ-cells and sperm-cells of parental organisms before they blend in the fertilized ovum. Most of Weismann's argument is directed to show that the fertilized ovum itself cannot be affected by any transforming influence acting upon the mother during the growth of the embryo. This may be true but it is unimportant. The time required to develop the embryo is too short for the environment to produce any material change however strongly the tendency might be at the time in the direction of such change. It is chiefly the uncombined sexual elements which are admitted by all to be undergoing specific transformation. The Neo-Darwinians deny that this is due to admittedly parallel transformations going on in the individual, the result of external and internal influences

upon the developed body; the Neo-Lamarckians consider the latter as in great part the cause of the former, while admitting that other variations are taking place due to unknown causes and that these are seized upon by natural selection to the advantage of the species.

The difficulty, on Weismann's theory, of accounting for any variation at all above the protozoans still confronts us. If external influences can only act on unicellular organisms in such a way as to be transmitted, it must follow that so soon as the multicellular stage is reached a rigid fixity must result. One of these lower metazoans may undergo important modifications during its lifetime, but its offspring are always set back to precisely the same place where the parent was when it set out. All these functionally produced changes are, according to him, utterly lost because they cannot react upon the germ-plasm. Where is the room for the action of natural selection? He has not dwelt upon this point, but he would probably say, though contrary to statements above quoted, that the germ-plasms are constantly undergoing spontaneous variation and that natural selection works on these. We would then be brought back to where we were a moment ago, with the question still before us, how spontaneous variations differ from functional ones (for he would not maintain that they were wholly uncaused effects), and why it is not logical and rational to assume that functional changes are impressed upon the germ-cells in ways which, though unknown to us, are no more unknown than is the cause of spontaneous variations. This seems to be far more reasonable than the far-fetched, and, as it seems to me, childish view recently expressed by Prof. E. Ray Lankester, that the environment does indeed influence the germ-cells but only by kaleidoscopically shaking up their contents, thus causing what are called "sports" in the progeny, and that natural selection seizes upon these, thereby securing advantageous transformations.

NEO-DARWINISM.*

We will next briefly pass in review the extraordinary discussion which has followed chiefly from the publication of Weismann's essays. As already remarked, they produced very little influence upon the German mind, and most German investigators who noticed them at all, either saw little in them or else attacked them with greater or less violence. It is almost exclusively in England that they have found favor, and here a veritable school of biologists has sprung into existence pre-

* The expression *Neo-Darwinian* was first used, so far as I am aware, by Dr. G. J. Romanes in a letter to *Nature* for Aug. 30, 1888 (Vol. XXVIII, p. 413), and occurs frequently in subsequent discussions. The substantive form *Neo-Darwinism* was a natural outgrowth from it.

pared to defend even the most extreme of Weismann's theories. It is due to the German investigator to say that, with the exception of the slight tendency above pointed out to dogmatize on the subject of the non-transmissibility of acquired characters, his essays are dignified and courteous and often evince an almost Darwinian modesty with regard to his own theories. Far different was the case with most of his English disciples. What he states as probable they assert as forever settled, and his working hypotheses become for them the fundamental truths of science. His papers were translated and reviewed, usually in an aggressive manner, before any one had ventured to criticise them. Being usually beyond the reach of any but the embryological specialist all except ardent disciples reserved their judgment and declined to enter the field. At first there was an attempt to make it appear that Weismann's views reflected only those of Darwin himself and that all outside of them consisted in deviations and wanderings from his doctrines. It was sought to stamp them with the name of "pure Darwinism,"* and the reader was frequently informed what Darwin really intended to say in certain passages which could not otherwise be made to harmonize with the new doctrine, and even in some still more refractory passages we are told what he would have said "if it had occurred to him."†

In default of any real opponent the Duke of Argyll, with his strong theological bias, his medieval spirit of logomachy, and his total lack of scientific ideas, was called out and set up as a sort of man of straw to be repeatedly demolished. But like the shadows in the valley of Walhalla, he emerged each time unscathed and renewed the deathless struggle. His presence in the arena had the further advantage for the new school of affording them an opportunity to point to him as a sample of the opponents of Weismann.

Against all this a few protests were raised from time to time and after the appearance of the English edition of the essays a few able and critical analyses were made. But the general character of the discussion as it has gone on in the columns of *Nature* and in the British magazines is such as I have described. The only other prominent or frequent contributor in answer to the disciples of Weismann is Dr. G. J. Romanes, and he has been more especially concerned with defending his priority to the idea which he has elaborated under the name of Physiological Selection, and to the discussion of certain phases of the law of *panmixia* which he claims to have discovered. It would, however, be unjust to deny that the discussion has been of value to science, since, had it done no more than to attract wide attention

* *Nature*, Vol. XXXVIII, Aug. 16, 1888, p. 364; Aug. 23, 1888, p. 388; Vol. XL, pp. 567, 619.

† See *Nature*, Vol. XLI, March 27, 1890, pp. 487, 488.

to so momentous a question it could not have been without its uses.

NEO-LAMARCKISM.*

Let us inquire what has really been done from first to last toward the demonstration, or scientific establishment of the law of transmission of functionally acquired characters and the preservation through heredity of the modifications produced by changes in the environment. It will not be necessary to go back to Lamarck as his presentation of the subject has been sufficiently dwelt upon. But I cannot agree with some recent writers that Lamarck was defending a totally different principle from that which is being defended to-day. It is true that Neo-Lamarckians recognize natural selection as an equally, and in some respects far more potent law, although, as has been justly insisted upon, it does not explain the cause of the variations of which it makes use. The Lamarckian principle does this, so far as it goes, and affords a true mechanical, that is, scientific explanation of the origin of species.

After Darwin himself, whose methods were always those of the true naturalist, unquestionably the most successful defender of this view is Mr. Herbert Spencer, whose methods are always those of the true philosopher. A man of such originality would be incapable of approaching the subject from the same standpoint as any of his predecessors, and we find him evolving this law from his great general scheme of mechanical cosmology, in which it appears as one of the equilibrating forces of the organic world. It is his law of "direct equilibration," natural selection forming a second law of "indirect equilibration."

Through the operation of these two principles the phenomena of adaptation are explained. Adaptation is placed by him in what seems to be a new light, as the tendency of the organism to respond through modification of form and structure to an ever-changing environment. The introduction of this form of words by Mr. Spencer has been of the utmost value to science in affording it a clear and precise terminology for the most important of all phenomena. Lamarck floundered about in straining after such a terminology. As I have shown he generally used the word *circumstances* for Spencer's *environment*, but in many cases he employed the word *medium* (*milieu*) and he occasionally approached the Spencerian expression so nearly as to speak of the environing medium (*milieu environ-*

* Prof. A. S. Packard is believed to be the first to use the term *Neo-Lamarckian*. This he did in the introduction to the *Standard Natural History* (Vol. I, Boston, p. iii) in 1885, and on page iv he adopts the substantive form *Neo-Lamarckianism*. As the word *Lamarckism* had already been long in use the shorter form *Neo-Lamarckism* should be preferred.

nant)*. His idea was undoubtedly the same, but he lacked both the literary training and the philosophic power to present it in its best light.

Mr. Spencer showed that the general proposition that the organism must be permanently, constantly, and profoundly influenced by the environment is one that cannot be logically escaped. It is not a mere *a priori* deduction, but rests upon all the facts and phenomena of the organic world which he marshaled in a most masterly manner in its support. But the Neo-Darwinians who deny this because it conflicts with their new hypothesis, never cease to demand facts. Haeckel's reply to this was eminently just, that this new hypothesis is itself wholly unsupported by facts, in the sense in which they use the term. It is an inference from the study of embryology, and an opposite inference is as legitimate as the one they draw. The truth is that the real phenomena of heredity are too recondite for direct observation. We are dealing with the ultimate units of organic being and are compelled to judge of their actions by the general results. But Mr. Spencer went further than any one had done before him and brought together an immense array of the most convincing facts upon his side of the question. Although he wrote before the new hypothesis had been proposed he seems to have fairly anticipated it, and one is surprised to find the objections of the Neo-Darwinians clearly stated and squarely met. It would be needless to repeat his arguments here, even if there were time, but I may call attention especially to that which relates to the origin of those correlated structures which are necessary to render effective the modifications which natural selection or sexual selection has produced. He shows that unless these are due to inherited functional variations a series of violent assumptions must be made which put one's credulity to the severest test—not a pre-established harmony, but a multitude of pre-established harmonies, all of which must co-operate with unerring exactness. Under the hypothesis of the hereditary preservation of the functionally produced modifications necessary to secure these correlations the explanation is perfectly simple and rational. This argument, so far as I know, has never been answered, nor has any attempt been made to answer it.

Early in the discussion of Weismann's theory and three years before the appearance of the English edition of his essays, Mr. Spencer seems to have foreseen their probable effect in England, and he turned aside from his systematic labors to reargue this question in the light of fresh facts and evidence. This he did in two articles in the *Nineteenth Century* for April and May, 1886, which are characterized by an unfailing vigor

* *Philosophie Zoologique*, Vol. II, pp. 5, 304.

of treatment and all the philosophic power which he is wont to display in the discussion of biological questions. I would especially commend the second of these articles as an altogether fresh presentation of the case, replete with facts from the lowest forms of organized life. Many of these taken from the vegetable kingdom come home to me with great force, and it seems difficult to see how another interpretation can be put upon them.

Prof. Karl Semper published in 1881 as one of the International Scientific series his *Natural Conditions of Existence* as they affect Animal Life, in which he supports the same class of views by many observations from his own profound studies. Prof. Sidney H. Vines in his *Lectures on the Physiology of Plants* (1886) offered some direct and telling strictures upon Weismann's teachings (Chap. XXIII), and after the English edition of the essays appeared he repeated these and answered categorically a large number of points in a communication to *Nature*.* Professor Weismann replied to this review, defending himself satisfactorily at some points, but was compelled to recede from several of his most important positions.

Mr. Patrick Geddes advanced in the *Encyclopedia Britannica* (Art. Variation and Selection) a somewhat novel theory of variation in plants, substantially in the same line, but probably with some vulnerable points, and Professor Henslow's recent work on the *Origin of Floral Structures*, seeks to show that "the responsive actions of the protoplasm in consequence of the irritations set up by weights, pressures, thrusts, tensions, etc., of insect visitors," have played the principal rôle in determining the forms of irregular flowers. In much of all this there is a tendency to extremism, and harm is often done by neglecting to recognize the action of natural selection where it is clearly present, but there always remains a residuum of facts which cannot be explained by that hypothesis.

Among those Germans who have so ably and systematically opposed the views of Weismann should doubtless first be mentioned Dr. G. H. Theodor Eimer. The work† in which he has most effectively undertaken this has been translated into English by Mr. J. T. Cunningham,‡ who is one of those who early took part in the discussion. The title of this work as well as the heads of some of the chapters (such as: "The Influence of Adaptation in the Formation of Species," "Mental Faculties as Acquired and Inherited Character," "Evolution of the Living World as the Result of Function," etc.) shows how directly Eimer antagonizes Weismann, and one of the leading merits of the book

* Vol. XL, Oct. 24, 1889, p. 621.

† *Die Entstehung der Arten auf Grund von Vererbung erworbener Eigenschaften nach den Gesetzen organischer Wachstums*, Jena, 1888.

‡ *Organic Evolution as the Result of the Inheritance of Acquired Characters*, London, 1890.

is the great number of new illustrations that it contains in support of his position.

Perhaps I should not pass over, in this imperfect survey, the able and very temperate paper of Mr. J. Arthur Thompson,* who, of all the writers here noted, comes the nearest to having anticipated the point of view of my own criticisms. The bibliography of the general subject which this writer gives at the end of his paper will enable any one who desires to pursue it further to supplement this brief enumeration to any extent, and also to take a retrospective view into its history and progress.

It would be easy to select from these and other works any required number of illustrations of the transmission of acquired characters, but there would not probably be one that Weismann would not find means of explaining away. He has taken up a number of such in his essays, stated them with sufficient fairness, and then proceeded to show that they are also capable of another interpretation. In some cases this is doubtless true, but in most cases his explanations seem strained and unnatural. In many they amount to an admission that the quality transmitted was functionally acquired and that the changed environment has actually influenced the germ. But he always insists that this does not constitute an acquired character. I do not see why it does not. For example, he says: "It is difficult to say whether the changed climate may not have first changed the germ, and if this were the case the accumulation of effects through the action of heredity would present no difficulty" (p. 98). I cannot see why this is not conceding the whole issue. Of course all modifications must first affect the germ, otherwise there could be no hereditary transmission. The only question is: Can the climate or the environment impress changes upon the germ? If yes, the Neo-Lamarckian asks no more. All that he contends for is conceded.

The quotation just made is from one of his earlier essays and he has objected to its being urged against him on the ground that it does not represent his latest conclusions. But what has he to say to the following from his eighth and last essay originally delivered in September, 1888?

"It is therefore possible to imagine that the modifying effects of external influences upon the germ-plasm may be gradual and may increase in the course of generations, so that visible changes in the body (*soma*) are not produced until the effects have reached a certain intensity" (p. 433).

It matters nothing to the Neo-Lamarckian whether the effects of external influences become visible in the first or the hundredth generation. The whole question is: Are they the cause of the modifications that actually take place? Weis-

* The History and Theory of Heredity. Proc. Roy. Soc. Edinburgh, Vol. XVI, 1888-'89, pp. 91-116. (Read Jan. 21, 1889.)

mann's English followers deny this and say that such modifications are due to the selection of accidental variations in the germ, and so in all cases. If the term "acquired" is to be any further refined away, then discussion is useless, for it is not a mere dispute about a word that interests us, but the fundamental question whether external conditions do or do not permanently and progressively influence the development of organic beings.

THE AMERICAN "SCHOOL."

Probably the strongest arguments that have been brought forward upon the affirmative side of this question are those derived from paleontology, and singularly enough, hitherto, so far as I am aware, this view of the question has been presented, with the single exception of Kovalevsky, entirely by Americans. This work was not done under the stimulus of Weismann's writings, because most of it was already accomplished before his essays appeared.

As far back as 1866 Prof. Alpheus Hyatt read a paper "On the Parallelism between the different stages of life in the Individual and those of the entire Group of the Molluscan order Tetrabranchiata,"* in which were foreshadowed the views more definitely expressed in 1880 in his papers "Upon the Effects of Gravity on the forms of shells and animals,"† and "The Genesis of the Tertiary Species of Planorbis at Steinheim."‡ In these papers Professor Hyatt showed the moulding influence of what in this case happened to be an environment growing gradually less and less favorable, but not the less adapted to display in a very clear light some of the most important laws of transformation.

In 1877 Mr. John A. Ryder read a paper "On the laws of digital reduction,"§ showing the obvious adaptations to the changing environment which had taken place in vertebrates in this respect, and a year later he pursued the same line of argument for modifications of the teeth.¶

Mr. Ryder has for many years past been engaged in embryological researches, but there is no evidence that they have led him to abandon the views expressed in these earlier papers in favor of those of Weismann. On the contrary, several comparatively recent papers of his** consist in great part of direct attacks

* Mem. Bost. Soc. Nat. Hist., Vol. I, p. 193. (Read Feb. 21, 1866.)

† Proc. A. A. A. S., 1880, p. 527.

‡ Mem. Bost. Soc. Nat. Hist., Fiftieth Anniversary, 1880. Second Memoir.

§ American Naturalist, Vol. XI, October, 1877, pp. 603-607.

¶ On the mechanical genesis of tooth forms, by John A. Ryder. Proc. Nat. Sci. Phil., Vol. XXX, 1878, p. 45; Vol. XXXI, 1879, p. 47.

** The Origin of Sex through Cumulative Integration and the Relation of

upon Weismann's teachings and criticisms of his embryological theories.

Professor Cope commenced publishing on this subject at about the same time and has continued to study the vertebrate fauna of America without interruption to the present time. It appeared to him from the first that paleontology affords proof of the causes of variation, as revealed in the wonderfully complete transition series that are found in the teeth, toes, and various parts of the skeleton of extinct animals, adapting them to a changing environment and higher structural perfection. The study of living animals cannot, in the nature of things, afford any such series of forms, and the evidence from paleontology is particularly striking in this respect. A volume of Professor Cope's memoirs was published in 1887 under the title of "The Origin of the Fittest," by which title he aimed to express the idea of the cause or origin of modifications that have taken place, as distinguished from Darwin's explanation of the laws of transformation based on the assumption of such modifications taken as simple facts of observation. Both methods are scientific, but the former carries us one step nearer to the true origin of things.

More recently Prof. H. F. Osborn of Princeton College has taken up this line of argument and presented it in several memoirs in which he has attempted a direct answer to Weismann's charge that no facts have been furnished in support of the transmission of acquired characters.*

In the latest of these papers, that read before the Society of Naturalists in Boston, December 31, 1890, not yet published, but of which an advance copy was kindly sent me by him, he has stated the whole problem with a judicial fairness which all must admire, and with a keenness of analysis which places him in the front rank of modern biological thinkers.

Perhaps the most important contribution which he has made to the subject is that in which he shows that 'the main trend of variation is determined not by the transmission of the full adaptive modifications themselves, as Lamarck supposed, but of the disposition to adaptive atrophy or hypertrophy at certain points.'

This principle goes farther than any other that has been brought forward to differentiate Neo-Lamarckism from Lamarck-

Sexuality to the Genesis of Species. Proc. Am. Phil. Soc. Vol. XXVIII, May 29, 1890, pp. 109-159.

A Physiological Hypothesis of Heredity and Variation. Am. Nat., Vol. XXIV, January, 1890, pp. 85-92.

* Proceedings of the American Association for the Advancement of Science, Vol. XXXVIII, 1889 (Toronto), pp. 273-276.

British Association Report, 1889 (Newcastle-upon-Tyne), p. 621; Nature, Vol. XLI, Jan. 9, 1890, p. 227.

American Naturalist, Vol. XXIII, July, 1889, pp. 561-566.

ism proper, while at the same time it is an effective answer to a large part of the argument directed against the transmission of functionally acquired characters.

Professor Osborn has probably made the most of the argument from paleontology, and it must be left to the candid judgment of scientific men to say whether the case is made out. It is of course always possible to say that the initial variations which inaugurate each new adaptation were merely accidental and were seized upon by natural selection, and it is to a large extent a question of faith in the universal efficacy of that theory; or rather a question in candid minds of the relative reasonableness of that view and of the view which ascribes a considerable part of this initial variation to functionally produced modifications transmitted by heredity.

It would be unjust to this Society to omit in an enumeration, however imperfect, of the American defenders of the transmissibility of acquired modifications, your former president Prof. W. H. Dall, whose protracted studies in invertebrate paleontology, conchology, and especially the molluscan life of the deep sea have led him to a full accord with other American workers as regards questions of this class. In his presidential addresses, not to speak of earlier papers, he has emphasized the molding influence of the environment upon the plastic organisms with which he is most familiar, and during the past year he has contributed to the Society one paper* dealing directly with the Neo-Darwinian claims, in which the case is as clearly presented as it has been by any other writer, and in many respects in an entirely new light.

For myself, I cannot claim to have made any direct contribution to this specific subject. I have been deeply interested in the development of plant life and have from time to time within the past fifteen years presented this theme from every point of view that I have been able to see it. I recognize the law of natural selection as probably the most potent of all organic laws, but I have never doubted that a great part of the variations upon which its action depends are due to reactions of the organism upon the environment, and after reading Weismann's essays and every scrap of discussion that I have been able to find arising from them, I am still so dull as to remain unconvinced that such modifications are incapable of hereditary transmission. To say that the environment may and must influence the germ, but that it can only influence it in a haphazard way analogous to that in which a jar affects the figures of a kaleidoscope, is to my mind a begging of the question, and I prefer to assume that there is a causal connection between the nature of the influence on the germ and the alterations that

* On Dynamic Influences in Evolution, by W. H. Dall. Proc. Biol. Soc. Wash., Vol. VI, pp. 1-10.

result, especially as the latter are admitted to be in harmony with the former.

If I have succeeded in showing in one of my papers before this Society* that considerable variation is constantly taking place irrespective of any advantage to the species, this much at least has been withdrawn from the domain of natural selection, and if these changes are not produced by that law there seems no escape from the conclusion that they are caused by some unknown external influences.

In the foregoing review of the work that has been done toward the scientific demonstration of the transmissibility of functionally acquired characters I do not pretend to have given the arguments themselves. I have only pointed out the fact that they have been presented, by whom, from what branch of science, and under what circumstances, and I must leave it to each of you, if sufficiently interested, to study them for yourselves from the original sources.

APPLICATION TO THE HUMAN RACE.

The wide-spread agitation of a problem of this nature, however technical or recondite it may be, lying as it does on the very ocean bed of science, cannot help sooner or later making itself felt at the surface and producing its normal influence upon the great practical questions of the moral and social world. And the nature of this influence, fortunately for us, is some indication of the truth or falsity of the views defended. Just as the mathematician knows, when his calculations lead him to just and rational results, that his assumption was a true one, and when they lead to a series of negations and absurdities, that it was a false one, so we may expect that if the assumption of the non-transmissibility of acquired characters is a sound one the practical conclusions that flow from it bearing upon the affairs of life will harmonize with the best thought on the development of the human race; and conversely, if its application to practical life conflicts with such best thought and with the facts of history and of social progress we are justified in the inference that it is an unwarranted assumption. What do we find?

The highly artificial character of what we call civilization is a fact which I have for many years sought to enforce by a variety of illustrations. That nothing like it could ever result from the natural flow of the forces that have combined to produce it is too obvious to require explanation, and that human advancement in general is exclusively the result of the exercise of man's intellectual power in the artificial direction of the raw forces of nature into channels of human advantage,

* Fortuitous Variation as illustrated by the genus *Eupatorium*. Abstract in *Nature* (London), Vol. XLI, July 25, 1889, p. 310.

is a proposition which only needs to be understood to be universally admitted. The tendency of the scientific mind to apply to social phenomena the canons that prevail in the non-intelligent world, is at least as ancient as the French physiocrats, Adam Smith, Ricardo, and Malthus, and it has been strengthened since Darwin by the writings of some of the ablest social philosophers. It rests on the seductive idea that what nature does must be well done, and that nature's methods must be the best methods for man to adopt. I have hitherto designated this kind of philosophy as a sort of nature-worship, and shown that the entire fabric of reasoning crumbles away at the first touch of critical analysis. But it is a fascinating habit of thought and difficult to dislodge from a certain type of mind.

Now on examining the practical applications which the Neo-Darwinians make of their underlying conception, I find them to be strikingly in line with those last described. If nothing that the individual gains by the most heroic or the most assiduous effort can by any possibility be handed on to posterity, the incentive to effort is in great part removed. If all the labor bestowed upon the youth of the race to secure a perfect physical and intellectual development dies with the individual to whom it is imparted, why this labor? If, as Mr. Galton puts it, nurture is nothing and nature is everything, why not abandon nurture and leave the race wholly to nature? In fact the whole burden of the Neo-Darwinian song is: Cease to educate, it is mere temporizing with the deeper and unchangeable forces of nature. And we are thrown back upon the theories of Rousseau, who would abandon the race entirely to the feral influences of nature.

The great men who talk this way, trained in the methods of the university, their minds stored with the fundamental, comprehensive, and organized materials for thinking and working which modern methods of education could alone have given them, use these materials, and take advantage of this training to spin out a subtle thread of reasoning which results in condemning the only means by which they were enabled to comprehend questions of this nature. Professor Weismann could never have prosecuted those prolonged investigations which have given him such a grasp of the intricate problem of heredity had he not been trained in the rigid methods of the German universities. Nay, those rigid methods themselves have been the product of a series of generations of such training, transmitted in small increments and diffused in increasing effectiveness to the whole German people. It has not been brought about by natural selection which only selects such ancestral germ-plasms as increase the certainty of reproduction. Such habits of mind could have no such tendency. They secure no advantage in the struggle for existence. And the fact that out of the barbaric German

hordes of the Middle Ages there has been developed the great modern race of German specialists is one of the most convincing proofs of the transmission of acquired characters, as well as of the far-reaching value to the future development of the race of such an educational system as that which Germany has had for the last two or three centuries.

It was said of Mr. Darwin that he was himself a good illustration of the law of atavism which he formulated since his habit of mind lay latent in his father and came to him from his grandfather Erasmus. Similarly it might be said that Professor Weismann is as good an example as need be asked of the transmission of acquired characters and of the hereditary embodiment of that wide-spread German characteristic which has been the increasing product of the German educational system and of German institutions.

Mr. Herbert Spencer has followed out this same line of reasoning as applied to the great development of the musical faculty in Germany, and shown that the Haydns, Mozarts, Beethovens, the Liszts, Rubinsteins, and Wagners, have formed, as it were, the several peaks of a great hereditary musical uplift in the German nation. The same is true of Italy, not only in music, but especially in sculpture, and we have there, so to speak, a race of sculptors. Those who, without any patriotic bias, compared the Italian and American pieces at the Centennial Exhibition could not help being impressed with this. There could be seen the most exquisite pieces of statuary, in which not only features of rare perfection and beauty, but every form of drapery were represented in marble with a true-ness to life that almost deceived the looker-on. And to such pieces were attached, not one or two celebrated names, but a great number of names of artists unknown to the public outside of those who make sculpture a special study. Contrasting these perfect productions with the lifeless ones that represented the highest reaches of American sculpture, even those produced by Americans who had spent many years at Rome and worked in an atmosphere of Italian sculpture, I was impressed with the little that a single generation can accomplish in such things, and with the fact that in Italy we have a race of born sculptors who inherit their deftness from ancestors as remote as Michel Angelo.

Weismann has not ignored the arguments from this side, but his attempts to meet them are among the weakest of all his reasonings. Here are some samples of them:

"The children," he says, "of accomplished pianists do not inherit the art of playing the piano; they have to learn it in the same laborious manner as that by which their parents acquired it; they do not inherit anything except that which their parents also possessed when children, viz., manual dexterity and a good ear" (p. 269). "The pianist . . . may by practice develop the

muscles of his fingers so as to ensure the highest dexterity and power; but such an effort would be entirely transient, for it depends upon a modification of local nutrition which would be unable to cause any change in the molecular structure of the germ-cells, and could not therefore produce any effect upon the offspring" (p. 278).

If this were true nothing is more certain than that the talent for piano execution could be no higher in the ten thousandth generation than that attained during the first, and that the curve representing the progress of music, sculpture, the talent for special scientific research, or any other form of genius, would be an irregular line with absolute average horizontality instead of what we know it to be in every case, an irregular, but progressively ascending curve marking a great forward movement.

It is universally conceded that the evidence for the transmission of acquired mental qualities is much stronger than for those of any other class, chiefly because they are entirely withdrawn from the action of natural selection, not tending in the least to the survival of the fittest. It has therefore been necessary for Weismann to deny their transmission at all. This is so palpably contrary to the facts of human history that few have been willing to follow him to this length. It is well known that Mr. Wallace has always excepted the human race from the action of natural selection, but in so doing he has seen fit to abandon the scientific method entirely, and in his last work he makes a complete break in the continuity of development with the advent of the higher psychic faculties, calling in an independent spiritual attribute to account for this class of phenomena. Prof. E. Ray Lankester, the foremost of Neo-Darwinians, in reviewing this work of Mr. Wallace* makes the following remarks on this point:

"Mr. Wallace's contention that the mathematical and artistic faculties of man have not been developed under the law of natural selection must in large part be conceded . . . their sudden and rapid development to a very much higher level in civilized communities cannot be traced to the struggle between man and man. It does not however follow that, because natural selection will not account for these extraordinary developments of the human brain, therefore we must have recourse to the assumption of supernatural agencies. Mr. Wallace seems so much convinced of the capability of the principle of natural selection, that when it breaks down as an explanation he loses faith in all natural cause, and has recourse to a metaphysical assumption."

But Prof. Ray Lankester, estopped by his consistent defense of Weismann's views, is obliged to ignore the obvious explanation that the intense exercise of these faculties, impressing itself profoundly upon the plastic brain substance and reacting upon the germs of posterity, has been transmitted to descendants through centuries of developing civilization, and he has recourse

* *Nature*, Vol. XL, Oct. 10, 1889, pp. 569-570.

to his doctrine of "sports" and to Gulick's law of "divergent evolution" which is nearly the same as what I have called "fortuitous variation."

But we need not confine ourselves exclusively to the mental qualities. A favorite illustration of the efficacy of selection is the progress which has been secured in the fleetness and other desired qualities in horses, and Mr. Wallace, in the *Fortnightly Review* for September, 1890, has instituted a contrast between what would result in this direction from a system of intelligent breeding and one of mere feeding and exercise. His illustration is thoroughly unfair, even ridiculous, since he does not attempt to transmit the acquired superiority but allows it to be diluted and lost by promiscuous breeding with stock that has not been subjected to any training. As a matter of fact training enters largely into the development of superior breeds of horses, and great care is taken that educated strains be bred together. And breeders as a rule would ridicule the idea that all their training goes for nothing, and that it is only accidental variations that can be bred into the new race of horses.

But let us take another case in which natural selection is wholly excluded. It is well known that a steady and uniform progress has been going on for a century or more in all forms of gymnastic skill and feats of bodily suppleness by men constantly in training for the purpose, which is comparable to that which has taken place in the trotting power of horses. Every year new wonders are brought before the public and the feats of the previous year are exceeded by some fresh virtuoso. This is accomplished, I am told, by lifelong training of the children of acrobats and of their children, thus producing, as it were, a little race of acrobats. What care is taken to prevent the loss of much of this through marriage outside of the trained stock, I do not know, but certain it is that great progress in physical development has taken place and is taking place, and there is no doubt whatever that it is largely due to the transmission of the qualities directly acquired by training.

In fact, Mr. Galton's conclusions, notwithstanding his doubts about the transmission of acquired talents, are not only not opposed to that view but in great part confirmatory of it. He is led by a carefully conducted series of inquiries and investigations to believe that genius is in the main hereditary; that the exceptionally talented and highly endowed are descended from talented and highly endowed parents, etc. But this only throws the question back one generation farther, and it remains to be shown that such talent and endowment in their ancestors were not the result of education, personal effort, or some other form of acquirement and not of mere accident.

But the great debate on heredity seems destined to secure still other and more far-reaching advantages. Not only has it

assured us that we may hand our good works down to posterity through the law of the transmissibility of acquired qualities, but it may and should teach us that the all-powerful law of selection is also an instrument in the hands of intelligence for the working out of human destiny. It is the right and the duty of an energetic and virile race of men to seize upon every great principle that can be made subservient to its true advancement, and undeterred by any false ideas of its sanctity or inviolability, fearlessly to apply it. Natural selection is the chief agent in the transformation of species and the evolution of life. Artificial selection has given to man the most that he possesses of value in the organic products of the earth. May not men and women be selected as well as sheep and horses? From the great stirp of humanity with all its multiplied ancestral plasms—some very poor, some mediocre, some merely indifferent, a goodly number ranging from middling to fair, only a comparative few very good, with an occasional crystal of the first water—from all this, why may we not learn to select on some broad and comprehensive plan with a view to a general building up and rounding out of the race of human beings? At least we should by a rigid selection stamp out of the future all the wholly unworthy elements. Public sentiment should be created in this direction, and when the day comes that society shall be as profoundly shocked at the crime of perpetuating the least taint of hereditary disease, insanity, or other serious defect as it now is at the comparatively harmless crime of incest, the way to practical and successful stirpiculture will have already been found.

June, 1891—Ætat. 49.

292. [Advertisement of Neo-Darwinism and Neo-Lamarckism]

History.—When I received my 200 reprints of the address, March 27, 1891, I wrote to Mr. Hodges, then editor of *Science*, and asked him if he would undertake to sell some of them. He replied on April 2, that he would do so and allow me 50 per cent on the retail price. The transaction is described in the history of the address (*supra*, p. 254). I was preparing my bibliography for the year ending June 30, 1891, for publication in the Smithsonian Report, and the language of the advertisement is the same as that of my summary of the contents of the address (see *infra*, Vol. V, No. 354) which occurs on pp. 762–763 of the *Report of the U. S. National Museum* for that year. The advertisement stood in the advertising department of *Science* for two or three years, some of the time heavily leaded.

NEO-DARWINISM AND NEO-LAMARCKISM.

BY LESTER F. WARD.

Annual address of the President of the Biological Society of Washington delivered Jan. 24, 1891. A historical and critical review of modern scientific thought relative to heredity, and especially to the problem of the transmission of acquired characters. The following are the several heads involved in the discussion: Status of the Problem, Lamarckism, Darwinism, Acquired Characters, Theories of Heredity, Views of Mr. Galton, Teachings of Professor Weismann, A Critique of Weismann, Neo-Darwinism, Neo-Lamarckism, the American "School," Application to the Human Race. In so far as views are expressed they are in the main in line with the general current of American thought, and opposed to the extreme doctrine of the non-transmissibility of acquired characters.

Price, postpaid, 25 cents.

N. D. C. HODGES, 874 Broadway, N. Y.

July, 1891—Ætat. 50.

293. [Two Views of Political Economy]

History.—Remarks on the paper of Prof. Simon N. Patten on *The Educational Value of Political Economy*, read Dec. 29, 1890.

Report of the Proceedings of the American Economic Association at the Fourth Annual Meeting, Washington, D. C., December 26–30, 1890. Publications of the American Economic Association, Vol. VI, Nos. 1 and 2, January and March, 1891, pp. 102–103. Appeared in July, 1891.

I WISH to make a remark that relates to what I shall call the two methods of study, or of contemplating the general subject of economics. It is a good thing to dwell on the great difference which exists between the modern economy and the old economy, and probably the forcible antithesis which was presented by our president in his opening address was not overdrawn. At the same time it has never seemed to me exactly in the light of a revolution, as some at times seem to regard it, but rather as a change which has taken place in the method of contemplating economics, and I am not sure but that we look as much as ever at the subject from the old point of view, and the change seems to me to be chiefly in the fact that we have also come to look upon it from the new point of view.

The old point of view of studying political economy has always seemed to me to be well expressed by the term historical, and still better by the term that we have sometimes used,—the natural history method. The old economists looked upon human society and the phenomena of the economic world from very much the same standpoint from which the biologist contemplates animals and plants. The thirst for knowledge in the human mind as it has developed has been so great that nothing could prevent it from going into every possible nook and corner of the whole domain of thought and feeling, and from working out every principle that could be seized upon. The old economists were simply students of social life. They studied mankind, not as a matter of curiosity, but simply for the sake of obtaining information and working out a set of principles that would apply to human action and the phenomena of society. In more

modern times we have students of the science of anthropology, or ethnology, as it is perhaps more correct to name it. We have the works of Tylor, Maine, McLennan, and others. These students have been studying man from the ethnical standpoint with exactly the motives with which the old economists studied the phenomena of human society. The idea of its being for the purpose of bettering society was as completely absent from the mind of Ricardo as it was from the mind of Tylor in studying the primitive culture of the human race. They are simply studies in natural history, studies for the sake of increasing the body of knowledge of the phenomena and facts which are presented by everything that can be studied. And that is as legitimate a method to-day as it was in those times. But the great change seems to me to have been that modern students of economics have come to think about the phenomena of society, the great questions of political economy, its facts and phenomena, not merely as means of increasing the sum of human knowledge, but as means of grasping a certain series of laws and principles by which, if properly applied, the phenomena of society may be modified and guided, and the future condition of society improved.

July 24, 1891—Ætat. 50.

294. It Displeased the Czar.—Prof. Ward's Volumes Burned by the Council of Ministers

History.—Written July 21, 1891, and sent the same day to Mr. Henry L. West, then City Editor of the *Washington Post*, who attended to its insertion. A marked copy of the paper containing it was sent to Mr. Kennan. The latter's letter entire and an extract from *Free Russia* were published in the preface to the second edition of *Dynamic Sociology* (1897), p. xii.

The Washington Post, Washington, D. C., No. 4840, July 24, 1891, p. 5.

PROF. LESTER F. WARD, of this city, has received word that the Russian edition of his work, entitled *Dynamic Sociology*, has been burned by order of the council of ministers in Russia. The edition consisted of 1,200 copies of the first volume, the second not having been issued as yet, although it has been translated. The publisher's loss is estimated at 3,000 rubles. Prof. Ward gave Nikolaeff permission over a year ago to translate the book into Russian, and does not yet know what it is that the Russian government finds so bad in it.

The information to Prof. Ward was conveyed in a characteristic letter from George Kennan, who said:

"It is not every man who achieves the distinction of having his books burned by order of a council of ministers of the mightiest Empire on earth! I have tried in my humble way to serve the cause of liberty in Russia, but I haven't been able to do it with ability enough to get my writings burned. You are evidently a very dangerous man, but I am nevertheless, with sincere respect and esteem,

"Faithfully yours,
"GEORGE KENNAN."

August 30, 1891—Ætat. 50.

295. [Principles of Geologic Correlation by Means of Fossil Plants.]—Abstract

History.—Brief résumé in English of the portion of the paper read in French, Aug. 29, 1891, before the International Geological Congress at its meeting in Washington. The complete history will be given with the full text of the paper (see *infra*, p. 305). The abstract was written on the same day, and furnished to Mr. S. F. Emmons for publication in the English *Report of the Proceedings*, which appeared the following day.

Report of the Proceedings of the International Congress of Geologists, Fourth Day, August 29, 1891, pp. 3, 4.

December, 1891—Ætat. 50.

296. Administrative Report for the year ending June 30, 1889

History.—Written June 30–July 5, 1889. Although this volume is dated 1890, it was not issued until December, 1891.

Tenth Annual Report of the U. S. Geological Survey, 1888–89, Washington, D. C., 1890, pp. 169–175.

December 25, 1891—Ætat. 50.

297. Review of Fossil Botany, being an Introduction to Palæophytology, from the Standpoint of the Botanist. By H. Graf, zu Solms-Laubach, Professor in the University of Göttingen. Authorized English Translation by Henry E. F. Garnsly, M.A., Fellow of Magdalen College, Oxford. Revised by Isaac Bayley Balfour, M.A., M.D., F.R.S. New York, Macmillan. 8°

History.—Written Dec. 11-13, 1891; and somewhat expanded in the proof, received Dec. 21.

Science, New York, Vol. XVIII, No. 464, Dec. 25, 1891, pp. 360-361.

January (?), 1892—Ætat. 50.

298. Bibliography for the year ending June 30, 1889

History.—Regularly furnished as on previous years.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1889. Report of the National Museum, Washington, 1891, pp. 773-775. Published separately as a pamphlet with the title: **Bibliography of the U. S. National Museum from the Report of the National Museum, 1888-'89, pages 737-776.**

LESTER F. WARD. What shall the Public Schools teach?

The Forum, New York, v, July, 1888, pp. 574-583.

A defense of industrial education from the standpoint that it stimulates the constructive faculty and leads to the subjection of nature by man through invention, which is the process through which alone civilization takes place.

— True and False Civil-Service Reform.

The Historical American, 1, Cleveland, Ohio, July, 1888, pp. 25-30; *Belford's Magazine*, Chicago, Illinois, III, July, 1889, pp. 202-210.

Opposes the prevailing practice of attacking the personal character of office-holders as calculated to lower the moral tone of the service by deterring good men from accepting office; defends this class against such attacks and the service against indiscriminate charges of corruption; argues for a system that shall remove all inducements to office-seeking and secure the special training of those who are to transact the business of the state in the methods of government operations and the business of a nation.

— Dabney's Sensualistic Philosophy.

The Historical American, 1, Cleveland, Ohio, July, 1888, p. 78.

A rather severe adverse criticism of the matter, the manner, and spirit of the work reviewed, namely, "The Sensualistic Philosophy of the Nineteenth Century, considered by Robert L. Dabney, D.D., LL.D., etc. New and enlarged edition. New York: Anson D. F. Randolph & Co."

— Evidence of the Fossil Plants as to the Age of the Potomac Formation.

American Journal of Science, third series, XXXVI, August, 1888, pp. 119-131.

This paper was read by invitation before the National Academy of Sciences, at the U. S. National Museum, April 20, 1888. It deals chiefly with the results of Prof. William M. Fontaine's researches in this field, summarizing the data contained in his unpublished Monograph of the Flora of the Potomac Formation, and specially emphasizing the fact that the flora contains a large proportion of Jurassic types, and that its dicotyledonous forms are very archaic in character, constituting, in all probability, their earliest recorded appearance. It is maintained that, owing to this peculiar character, they do not necessarily prove that the Potomac Formation is Cretaceous.

— Asa Gray and Darwinism.

The Historical American, I, Cleveland, Ohio, August, 1888, pp. 85-92, with portrait as frontispiece to magazine.

This paper was read at the Gray memorial meeting of the botanical section of the Biological Society of Washington, April 5, 1888. It gives an historical account of Dr. Gray's early and sustained relations with Charles Darwin, his instrumentality in furthering the spread of his views, the nature of his acceptance of those views, and the manner in which, as a botanist, Dr. Gray has been able to utilize Darwinian principles as a working basis in his department of science.

— Our Better Halves.

The Forum, New York, VI, November, 1888, pp. 266-275.

It is maintained in this article that the female sex is primary and the male secondary in organic economy; that woman represents the principle of heredity, and that acquired qualities in woman are more regularly transmitted than in man. The alleged superiority of the males of animals is shown to be apparent only, and confined to some higher types, acquired chiefly through the operation of sexual selection. The conclusion is drawn that "the elevation of woman is the only sure road to the evolution of man."

— Ny a Anmärkning om Williamsonia af A.G. Nathorst. (Notice.)

Am. Journ. Sci., third series, xxxvi, November, 1888, p. 391.

Brief notice of a paper with the above title in the Öfversigt af Kongl. Vetenskaps Akademiens Förhandlingar for Juni, 1888, No. 6, announcing the discovery of *Williamsonia angustifolia* Nath., attached to *Anomozamites minor* (Brongn.) Nath.

— The Paleontologic History of the genus *Platanus*.

Proc. U. S. Nat. Mus., XI, Washington, 1888, pp. 39-42, plates XVII-XXI.

An attempt to trace the history of the genus back through the several formations in the United States to the Dakota group, and to show that many of the forms that have been referred to *Sassafras*, *Aralia*, *Liquidambar*, and *Aspidiophyllum*, are probably ancestral types leading up to it.

— American Weather. (Review.)

The Epoch, IV, January 25, 1889, p. 463.

Notice of General A. W. Greely's book, so entitled.

— The "King Devil."

Botanical Gazette, XIV, January, 1889, pp. 10-17.

An account of the discovery of a hawkweed (*Hieracium præaltum*) in 1879 near Carthage and Evans Mills, Jefferson County, New York, then a recent immigrant from Europe, and of an investigation and of its subsequent spread, and injurious effects; made in 1888 in the same locality.

The plant had then become a scourge to the farmers and had acquired the name of King Devil.

- Remarks on an undescribed vegetable organism from the Fort Union group of Montana.

Proc. Am. Assoc. Adv. Sci., Cleveland meeting, 1888, xxxvii, Salem, 1889, pp. 199-201.

Abstract of a paper read before the Geological Section of the American Association describing a very singular organism collected by the author on the Lower Yellowstone River near Glendive, Montana, believed by him to be a comprehensive type of vascular cryptogam related to *Ophioglossum*, *Isoetes*, and *Selaginella*. Illustrated by lantern views.

- The Paleontologic History of the genus *Platanus*.

Proc. Am. Assoc. Adv. Sci., Cleveland meeting, 1888, xxxvii, Salem, 1889, pp. 201, 202.

Abstract of a paper of same title read before the Geological Section of the American Association, illustrated by lantern views and published in full with 5 plates in *Proc. U. S. Nat. Mus.*, xi, 1888, p. 39 (*q. v. supra*).

- Some Social and Economic Paradoxes.

The American Anthropologist, ii, April, 1889, pp. 119-132.

The same paper revised and published in full which appeared in an abridged form in *Science*, vol. xi, April 13, 1888, pp. 172, 174-176. See brief abstract of contents under entry of that date.

- (Administrative Report to the Director of the U. S. Geological Survey for the year ending June 30, 1886.)

Seventh Annual Report of the U. S. Geological Survey, 1885-'86, June, 1889, pp. 123-126.

- (Carboniferous Glaciation.)

Public Opinion, vii, June 15, 1889, p. 221.

A notice of an article by Mr. C. D. White entitled: Carboniferous Glaciation in the Southern and Eastern Hemispheres, with some notes on the *Glossopteris* flora.

Attention is specially called to the importance of the view expressed in Mr. White's article that the *Glossopteris* flora, though Mesozoic in aspect, is probably Permian in age and is the true ancestor of the widespread Rhætic and Jurassic floras of the northern hemisphere, and was developed in reponse to the gradual lowering of the temperature at the period, replacing the true Carboniferous types which could not survive the change, and subsequently migrating northward on the return of the tropical climate to reappear at many points as a distinctive Mesozoic flora.

January, 1892—Ætat. 50.

299. Principles and Methods of Geologic Correlation by Means of Fossil Plants

History.—Written June 22 to July 4, 1891. Read before the Geological Section of the American Association for the Advancement of Science, Aug. 21, 1891. A duplicate typewritten copy was made and somewhat extensive corrections introduced from time to time in the course of work on this subject. When read on Aug. 21, large charts were hung on the walls illustrating the correlation. On account of its length I could not finish the reading at the morning session and the Section allowed me to conclude in the afternoon. This paper was dictated at my house to the phonograph, the cylinders taken to my office and taken off on the typewriter, then this was corrected and a final typewritten draft made. The last cylinder was dictated on June 29. As this paper and the one on the Plant-bearing Deposits of the American Trias (see *infra*, p. 306) were summaries of my large treatise on the Trias, it is difficult to keep their history separate and some of the dates may be confounded. It was thoroughly revised towards the end of October and sent to the *American Geologist*. The history of this paper is of course incomplete without the mention of the French draft of it, but that will be fully treated under the French title (see *infra*, Vol. V, No. 364).

The *American Geologist*, Minneapolis, Vol. IX, No. 1, January, 1892, pp 34-47.

January, 1892—Ætat. 50.

300. [The Glossopteris Flora]

History.—Remarks on the paper *On the Permian, Triassic, and Jurassic Formations in the East Indian Archipelago* (Timor and Rotti), by Dr. August Rothpletz, read Aug. 24, 1891. Written out on the same day. Some copies of the page were received on December 16, but the *Bulletin* did not appear till January, 1892.

Bulletin of the Geological Society of America, Proceedings of the Summer Meeting held at Washington, August 24 and 25, 1891, Vol. III, Rochester, 1892, p. 15.

January, 1892—Ætat. 50.

301. The Plant-bearing Deposits of the American Trias

History.—Written March 27 to May 8, 1891, with the longer title: *Relations of the Plant-bearing Deposits of the American Trias*. It was dictated to the typist, revised and corrected, and then copied on the typewriter in duplicate. The rough draft as corrected and the carbon copy are still in my possession. This is an abstract of my "Correlation Paper" of the Trias, and as these Correlation Papers will not form part of the present work, a brief account of them may be given in this place.

It was early recognized by the Geological Survey that one of the greatest needs was the correlation of American geological formations with those of the Old World, and the reference of them, as far as possible, to the great subdivisions that are recog-

nized by all geologists. This work was given out to the several Divisions of the Survey, each dealing with a special formation or age of the rocks of the country. But as I had charge of the fossil plants of all formations, I was asked to work out the correlation of all the American plant-bearing beds from the standpoint of their floras. I began with the Paleozoic, and prepared quite a manuscript and large tables of distribution of the Silurian, Devonian, and Carboniferous formations. Before I had finished this I had assigned the entire Paleozoic to Mr. David White, and I therefore turned the manuscript over to him to revise, correct, complete, and publish, as his own contribution, which he never did. I then took up the Mesozoic, beginning with the Trias, and first treated it in the same way I had the Paleozoic, completing a large manuscript with tables of distribution. This was all done from the extant literature without special study of the formation, my field work having been at that time in the Laramie Group of the West. But as the Trias of the eastern part of the country consisted of a narrow belt extending from the southern boundary of the State of Vermont in the Connecticut Valley to a point in North Carolina, and was easily traceable most of the way, I decided to make a reconnoissance of most of it and gain a clear idea of its nature. This was done mostly in 1890, nearly every part of it from Turner's Falls, Massachusetts, to Clover Hill, Virginia, having been personally examined. I was then ready to sum up results, and did so in this paper. The full treatment, including all the western beds and the results of prolonged explorations in after years, is contained in my "Status of the Mesozoic Floras of the United States," the first paper of which appeared in the *Twentieth Annual Report of the U. S. Geological Survey*, and the second paper constitutes volume XLVIII of the *Monographs* of the Survey, with a volume of text and a volume of plates. These and my memoir on *The Potomac Formation* in the *Fifteenth Annual Report*, with its supplement in the *Sixteenth*, entitled: *Some Analogies in the Lower Cretaceous of Europe and America*, bring the correlation up to the middle of the Cretaceous, and there I was obliged to leave it.

On October 18, 1890, I presented some of the general results of my studies in the Trias to the Biological Society of Washington in a paper entitled: *American Triassic Flora*, illustrating the distribution by some large charts. I continued work on the

Trias during most of the winter of 1890-91, and when I learned that the Geological Society of America, the International Congress of Geologists, and the American Association for the Advancement of Science were all to meet in Washington in August, 1891, I decided to lay some of my results before them in compact form. This paper was prepared at the time above stated, read by title before the Geological Section of the A. A. A. S. on Aug. 21, and abstract furnished, and in full before the Geological Society of America on Aug. 24. That Society issued memoirs in brochure form, and I expected this to constitute one of these, as many of no greater length had thus been published. When I received it on Jan. 9, 1892, it was in the form of an excerpt from the minutes published in the *Bulletin* and so tucked away that very few would notice it. I was offended and the next day I sent in my resignation as a member of the Society, upon which I insisted, and resisted all the repeated efforts to induce me to reconsider it, as well as later ones, to rejoin it.

Ibid., pp. 23-31.

March, 1892—Ætat. 50.

302. [Principes de Corrélacion géologique au moyen de plantes fossiles]

History.—This is a French translation made by Mr. S. F. Emmons of the English résumé of my paper that I gave him on the day it was read. It was not submitted to me for correction, and the word “paléobotanique” was printed “paléobotanie.” I detected it and called Mr. Emmons’s attention to it. It was probably corrected in a later edition, as it is in the *Compte Rendu* (p. 74). This does not seem to have appeared till March.

Congrès Géologique International, 5me Session, Washington, 1891. Procès-Verbaux des Séances, pp. 26-27; *Compte Rendu*, Washington, 1893, pp.

April, 1892—Ætat. 50.

303. The Utilitarian Character of Dynamic Sociology

History.—Written Nov. 16, 1891, to Jan. 13, 1892. This article was a kind of patchwork and is one of the most unsatisfactory of all my productions. It seems that there was a sort of indefinite arrangement that I should write a series of articles for Gunton's Magazine, then called *Social Economist*, which after appearing there were to be collected into a book. The subject was to be: *Dynamic Sociology in its Relations to Living Issues*. I wrote the first article, or Chapter I of the proposed book, Nov. 16–29, 1891, with the title: *Import of Social Science*, and sent it to Mr. Gunton, but he was taken sick about that time and the scheme fell through. I modified the article, changing the title to: *Sociology in its Relations to Modern Socialistic Tendencies*, and as such I read it as stated in the footnote. I revised it and changed the title to that which the article bears and on Jan. 15, 1892, I handed the manuscript to the editor of the *Anthropologist*.

The American Anthropologist, Washington, D. C., Vol. IV, No. 2, April, 1892, pp. 97–103.

AMONG the many erroneous ideas that prevail in the minds of those who are only partially acquainted with the work which has made the expression Dynamic Sociology somewhat familiar, perhaps the most common one is that it is a scheme of speculative philosophy, and, like all such schemes, far removed from the world of life and action.

It shall be one of the leading purposes of the present paper* to

* Part of a paper entitled: *Sociology in its Relations to Modern Socialistic Tendencies*, read before the Anthropological Society of Washington, December 15, 1891.

dispel, so far as possible, this impression and to point out the practical character of dynamic sociology. That science, while it recognizes too clearly the great permanence of social institutions as products of a slow evolution to promise any immediate radical reforms, nevertheless claims to embody the fundamental elements of ameliorative social processes which, when they shall have had time to develop, will be more sweeping and beneficent than anything promised by the most elaborate scheme of social reform.

Philosophy has passed through many stages since men began to think. Besides the theological, metaphysical, and positive stages so accurately described by Auguste Comte, it has also passed, or is now passing, from the speculative to the utilitarian stage. By speculative is not here meant solely the abstruse dialectics of the schoolmen and the idle imaginings of the early cosmologists. The term may be properly applied to all attempts to look into the operations of nature, mind, man, or society, by which alone a knowledge of the universe has been acquired. I venture to use it in this sense here and without stigma, and to draw the broad distinction between the speculative and the utilitarian methods—between activities devoid of moral purpose and those that aim to make something better.

All three of Comte's stages are more or less speculative, but philosophy is now undergoing another revolution and human thought is concentrating itself upon the practical. Men once thought for the mere pleasure of exercising the brain; philosophy was a form of amusement. They now think for a high moral purpose; philosophy has become a serious occupation. Throughout all past history the developing faculties have loved to probe the secrets of nature and discover all the facts, laws, and wide truths of the universe. But in all this the notion that the world was to be made any better thereby rarely entered the human mind. Vast realms of nature were explored; the properties and relations of all forms of matter were discovered; the laws of physical phenomena were searched out; the organic world was studied and made known; human history and social customs were recorded and minutely described; even the laws of trade—the production, distribution, and consumption of wealth—were closely inquired into. But all this was regarded from the purely objective standpoint. The students of man had no more thought of modifying the operations of society than the students of astronomy had of altering the movements of the stars. Philosophy, in so far as it was distinct from science, pursued the same method, and treated human life and social systems simply as so much fact to be contemplated and learned. The world was the passive object of study, and it was assumed that when its true character was understood the work of the philosopher was done. Just as for ages literature was pursued as a mental gymnastic and for the pleasure which the invention

of refined and usually obscure forms of diction afforded to the writer, so the pursuit of knowledge and the search for truth, which constitute science and philosophy, have been thus far chiefly conducted solely for the intellectual pleasure they yield.

There is no higher enjoyment than that experienced in the acquisition of knowledge. Compared to it the effort to persuade is painful. To receive the truth, whether from others, or especially from nature by an effort in searching it out, is an intense satisfaction; to impart it, whether in the capacity of an authorized teacher, or especially in that of an advocate, is always irksome and usually thankless and discouraging. Why, then, should any one ever undertake the latter? Only because impelled, whether wisely or unwisely, by a sense of duty, which in many minds overrides all considerations of advantage. If I were to venture a personal remark it would be to say that these reflections are the outcome of my own experience. The little corner of the world which I have chosen as a field of exploration yields me all the intellectual enjoyment I could wish, and, humble as it is, it still contains inexhaustible treasures of undiscovered truth. Only enough is known of the present vegetation of the globe to sharpen the appetite for further knowledge, while the whole surface of the earth is strewn with materials for this pleasing study. Still more inspiring is it to turn the lithographic pages of Nature's great book and read in the remains of extinct ancestral forms a history which it required eons to write and which closes where human history begins. The pursuit of such a science begets a feeling too deep to be called pleasure, and yet so elevating in its nature that in the presence of its revelations all human enterprises and social activities seem trivial and jejune; and I often ask myself why, in the midst of such a luxury of intellectual life, provided with occupation which yields the highest form of enjoyment, I should turn aside, even for an hour, to take up an almost hopeless task, involving the hardest labor and promising the scantiest returns.

From this point of view it is easy to understand why there are so few who have any concern for the social state, and why even the wisest of men are so willing to leave the future progress of civilization to the great laws of evolution which have brought it forward to where it is. The reason is equally clear why even those who confine their investigations to man and society are content to study these as the botanist studies the plant, for the satisfaction of knowing their history, their nature, and the laws by which they have been developed. There are a certain peace and a restful calm in such investigations. No argument is needed; no one's interests are involved; no prejudices are encountered; no acrimony is aroused. On a former occasion* I characterized this as

* Remarks before the American Economic Association at Washington, D. C., December 29, 1890. Report of the Proceedings of the Am. Econ. Assoc.; Publications, vol. VI, p. 102.

the "natural-history method" in political economy. It belongs to the speculative, contemplative, or purely objective stage of philosophy, which looks upon the universe as something to be made known, but as wholly beyond the power of man to alter or amend.

This habit of thought, preëminently useful in the pioneer ages of the world, has so deeply stamped itself into the texture of the human mind that now, when the time is ripe for grafting upon it a new and higher method, it is found exceedingly difficult to overcome the inertia of ages and introduce a truly utilitarian philosophy. Not that the existence of evil and wrong in the world has not always been recognized, or that it has not been known to many that these are largely due to a defective social organization; for almost the only protests against the speculative indifference of philosophy and science have taken the shape of schemes of social reform involving a more or less radical revolution in the nature of that organization. Each age has had its Fouriers, St. Simons, and Robert Owens, who would tear down the present social structure and build anew from the foundations, blind alike to the laws of evolution, under which society received its present structure, and to the tremendous solidity of all structures which are products of those laws. It is this divorce of science from reform, of the student from the victim of social wrong, that threatens society. It is the indifference of those who should know the remedy, the widening chasm between the doctors and doctrinaires on the one hand, and the drift of unorganized public opinion on the other; and to-day, when the yoke of an outgrown social system weighs heavier than ever and the spirit of revolt is almost ripe, philosophy and science stand back on the old platform of *laissez faire* and leave the field to an army of social reconstructionists with their conflicting and bewildering panaceas.

Few, indeed, have been the attempts to bring a recognition of law and sound scientific principles to bear upon this problem. "Dynamic Sociology," issued in 1883, was at least intended to be such an attempt, and one of the strongest proofs that it sustains this claim is found in the fact that it is objectionable to a certain class because it does not present any schemes of social reform. But this was not its purpose. Such schemes are, for the most part, worthless, and no man is capable of elaborating one which will succeed until much more is known of the fundamental laws of social action. A widespread popular acquaintance with the principles of sociology is the essential prerequisite to successful reform measures.

The collective mind is greater than the individual mind. Civilization illustrates this, whether we take the great systems of industrial art—machines, factories, railroads, and the rest—or the progress of scientific discovery, or the flights reached in music, painting, sculpture, and architecture, or the chief literary pro-

ductions of the race—in whatever direction we may look the fact is patent that the achievements of all men vastly exceed the possible achievements of any one man. So it must be with schemes of social reform. When the bright thoughts of all bright minds shall be crystallized into some vast social system that has survived the keen analysis of whole nations of well-informed and earnest men, there will probably come forth something substantial enough to begin with and plastic enough to admit of the future modifications which experience may prove to be necessary.

But it is none the less the essence of dynamic sociology to insist upon the necessity of action. It differs fundamentally in this from the philosophies above described. They teach the doctrine of inaction. They are satisfied with the world as it is. They are indifferent to the existing condition of things. They regard all evil as necessary. They treat only the natural history of man; and latterly, since this method has been called in question, the philosophers of the speculative school have assumed the attitude of denying, more or less absolutely, the possibility of modifying the action of what they call natural laws to the advantage of society. It is just here that dynamic sociology takes issue, and it confidently claims that its position is, in the fullest sense of the term, scientific.

While thus firmly maintaining the legitimacy and efficacy of social action, dynamic sociology, as already remarked, is sparing in its recommendations as to the proper direction of such action. The infancy of the whole science of sociology would naturally dictate this; but beyond that consideration it is really no essential part of the science proper to formulate a social polity. That belongs to the art which consists in applying the principles of the science and which may be called dynamic politics.

It belongs, however, to the science to teach that social progress must depend upon the intelligence of the individual units of which society is composed. It further teaches that the result will be proportioned, first, to the degree of intelligence; and, secondly, to the extent of its diffusion. The quality of intelligence is also an important factor. The maximum of success, therefore, in the amelioration of the social condition will be attained by the widest diffusion of the largest amount of the most important knowledge. Such is, in very brief terms, the argument for universal education, fully carried out, in the second volume of *Dynamic Sociology*.

The Russian government has done me the honor and itself the dishonor to condemn to the flames the Russian edition of that work. The motives that actuated the council of ministers in ordering this to be done have thus far proved inscrutable even to intelligent citizens of that empire. As there is nothing in the work which reflects upon the people of Russia or their rulers, it is to be supposed that it was condemned for the liberalizing

doctrines taught by it, and it has been surmised that prominent among these may have been that of universal education. However this may be, nothing is more certain than that the proper cure for Russia's woes is a general system of public instruction, and the Czar who shall inaugurate this reform and place it on a firm and permanent basis will confer upon Russia a far greater boon than the emancipation of the serfs has proved to be.

The utilitarian philosophy has been a product of the growth of moral ideas, and is due to the heightening of the sympathetic nature of man until the contemplation by a morally refined organization of the pains of others becomes itself a pain too acute to be endured. It thus has the same ego-altruistic basis as all benevolent and philanthropic actions, and differs from them only in its methods of relief. This difference of method consists in calling in the rational powers to devise some fundamental and systematic treatment of the evils of society instead of allowing the sympathies to control action directly toward the mitigation of individual cases. Instead of being merely therapeutic, as are all schemes of charity, it is prophylactic, and aims to remove the causes of the pathologic social state. Though arising from the warmest emotional sources, it proceeds by the coolest intellectual processes. It looks upon much of the prevailing charity as useless and even injurious, in tending to produce more suffering than it alleviates, because conducted in ignorance of the laws of human nature. While it would not abolish existing charitable institutions, but would reform them in harmony with those laws, it regards them as the temporary scaffolding of an ultimate social structure which will wholly obviate their necessity.

If it be said that these claims are as extravagant as those of other social reformers it will be admitted that the ends are not different, and that the latter often claim even less than most utilitarian philosophers concede to be attainable. The difference is in the methods, which in the one case consist in resisting the great current of natural development, while in the other case they utilize that current and make it do most of the work required to be done.

To this general group or system of ideas, constituting the modern utilitarian philosophy, it has been proposed to give the name *meliorism*. The science which underlies this doctrine and which can alone render it a successful principle of action is dynamic sociology. In my general work on the subject I have sought to lay the foundations of this science and nothing more. Current questions are rarely touched upon, but they were never out of my mind while writing it, and there is not one which does not find its proper niche in the system. So much space was necessarily devoted to fundamental considerations, especially to the difficult but unavoidable task of showing how dynamic sociology is based on statical sociology, biology, and the less

complex sciences, as indicated in the full title, that to have pointed out the application of each principle to the living issues that naturally grow out of it would have unduly expanded the work. Moreover, there were then excellent reasons for not attempting this, and I preferred to leave each reader to make such application for himself. But now the case is somewhat different. The great movement in public sentiment which I then foresaw has set in strongly, but like all such movements in their inchoate stages it is as yet little more than an expression of general discontent. It is crude, ill-digested, and sporadic, making unreasonable and often impossible demands which are calculated to repel the sober judgment of the conservative element and ultimately to bring about a reaction.

Under such circumstances it would seem to be the duty of all who recognize the laws that have operated to produce the movement to do what can be done to check its wayward tendencies and, as far as possible, to keep it within the normal channels of safe and healthy development. If this is not done those who are likely to suffer by its ravages are certain to resist its whole current until, no longer capable of restraint, it will burst forth in open revolution. What must be will be, but everything depends upon the manner of its being. The problem of to-day is how to help on a certain evolution by averting an otherwise equally certain revolution.

April, 1892—Ætat. 50.

304. Notice of a memoir Ueber Tertiärpflanzen von Chile; von H. Engelhardt. Abhandlungen der Senckenbergischen naturforschenden Gesellschaft, Band XVI, Frankfurt a. M., 1891, S. 629-692, pl. i-xiv

History.—Written Feb. 15-18, 1892. This and the five following notices were sent to Professor Dana together on March 12, the proof was received on March 16, and reprints on April 22.

The American Journal of Science, New Haven, Third Series, Vol. XLIII [Whole Number CXLIII], No. 256, April, 1892, pp. 335-336.

April, 1892—Ætat. 50.

305. Miocene Plants from Northern Bohemia.—Notice of memoirs Ueber fossile Pflanzen aus Tertiären Tuffen Nordböhmens, von H. Engelhardt. Ges. Isis in Dresden—Abhandl. 3, 1891, pp. 20-42, pl. i; and Ueber die Flora der über den Braunkohlen befindlichen Tertiärschichten von Dux; von H. Engelhardt. Nova Acta der Ksl. Leop.-Carol. Deutschen Akad. d. Naturforscher, Bd. LVII, No. 3, 1891, pp. 131-219, pl. iv-xvii

History.—Written Feb. 20-23, 1892.

Ibid., pp. 336-337.

April, 1892—Ætat. 50.

306. Calcareous Algæ.—Notice of Fossile Kalkalgen aus den Familien der Codiaceen und der Corallineen; von Herrn Rothpletz in München. Zeitschr. d. Deutsch. geol. Ges., Bd. XLIII, 1891, S. 295–322, pl. xv–xvii

History.—Written Feb. 24–26, 1892.

Ibid., p. 337.

April, 1892—Ætat. 50.

307. Notice of a memoir On the Fructification of *Bennettites Gibsonianus* Carr., by H. Graf zu Solms-Laubach. Annals of Botany, Vol. V, November, 1891, pp. 419–454, pl. xxv–xxvi

History.—Written Feb. 26, 1892.

Ibid.

April, 1892—Ætat. 50.

308. Notice of Le Nelumbium Provinciale des Lignites Crétacés de Fuveau en Provence; par le Marquis G. de Saporta. Mémoires de la Soc. Géol. de France, Tome I, Fasc. 3, Mém. No. 6, Paris, 1890, p. 9, pl. xii-xiv

History.—Written Feb. 29, 1892.

Ibid., pp. 337-338.

April, 1892—Ætat. 50.

309. Notice of Recherches sur la Végétation du niveau de Manosque; par le Marquis G. de Saporta. Mémoires de la Soc. Géol. de France, Tome II; I, Nymphéinées, Fasc. 1, Mém. No. 9, p. 22, pl. iii-vi; II. Palmiers, Fasc. 2, Mém. No. 9, pp. 23-34, pl. ix-xi

History.—Written March 8-9, 1892.

Ibid., p. 338.

May (?), 1892—Ætat. 50.

310. [How the Missouri River wears its Banks]

History.—Remarks on the paper on *The Laws of Corrosion*, by J. W. Powell, read Oct. 27, 1888. This is only an abstract of the much more extended remarks made. It was written for the Secretary's use on Nov. 11, 1888. I had already thoroughly worked the subject out (see *supra*, Vol. III, No. 176).

Bulletin of the Philosophical Society of Washington, Vol. XI, Proceedings at the General Meetings of the Society, 1888-1891, Washington, D. C., 1892, pp. 519-520.

July 24, 1892—Ætat. 51.

311. No Wonder it was Burned. [An account of the Polish translation of *Dynamic Sociology*, and discussion of the causes of the alleged burning of the Russian edition]

History.—Written July 21-22, 1892. The circumstances relating to both the Polish and the Russian editions were set forth as fully as possible in the preface to the second edition of *Dynamic Sociology*, published in 1897. All that I will add here is that the writer of the letter announcing the Polish translation was none other than Mr. Wladimir Lessevitch, mentioned in Mr. Kennan's letter, and whose death has robbed the Russian government of its power to do him further injury; and that the

writer of the other letter relative to "dynamite and socialism" was Mr. D. M. Henderson, a bookseller in Baltimore, whose personal acquaintance I never made.

The Washington Post, Washington, D. C., No. 5207, Sunday, July 24, 1892,
Part Second, p. 9.

RUSSIANS THOUGHT "DYNAMIC SOCIOLOGY" HAD SOMETHING TO
DO WITH THE BOMBS.

THE work entitled "Dynamic Sociology," written by Mr. Lester F. Ward, of this city, seems to be a sweet morsel under the Slavic tongue. In THE POST of July 24, 1891, an account was given of its translation into Russian and of the seizure and destruction of the Russian edition by the council of ministers. Notwithstanding this discouragement, and probably in full knowledge of it, the work has now been translated into Polish, and Mr. Ward has received the prospectus of the Polish edition, which is to appear in parts during the present year.

In a letter inclosing this prospectus a friend of Mr. Ward in Russia says:

"It is with the greatest pleasure I convey to you the announcement of the publication of your great work in the Polish language. The work is to appear at Warsaw in parts during the present year. It will be very interesting to see how the censors, who treated the Russian translation so barbarously will behave toward the Polish translation. It sometimes happens, though, that they conform to one of our proverbs, and have seven Fridays in a week [*i. e.*, have intervals of exceptionally good behavior]. This is our good fortune, and the only chink through which the light sometimes reaches us."

Replying to Mr. Ward's previous inquiry as to the cause of the seizure and burning of the Russian edition by the agents of the government, this correspondent in the same letter remarks:

"I have recently come to agree with a professor at . . . who believes that it is the title of the book, nothing else, that was the cause of their ferocity. Whether they read the book or not they surely said to themselves, 'the title suggests certain ideas; that is enough.' But what ideas? you will ask. Those of certain combinations of sound, calling forth certain specters! This must seem very strange in America. With us, not at all."

Coarse and ignorant as this explanation seems, Mr. Ward was not altogether unfamiliar with it. Several of his friends had suggested it, some of them seriously, and of the many letters he has received on the subject one expresses surprise that any one should be in doubt as to the reason for condemning a book whose very title was, to a Russian censor, "a compound of dynamite and socialism."

The word "dynamic" was borrowed by Mr. Ward from me-

chanics, which branch of mathematics is divided in all text books into statics and dynamics, and the term is now employed to denote the active stage of other sciences, as dynamic geology. It was a bold stroke to apply it to a new phase of social science, but the term was needed, and is now being used by such eminent political economists as Prof. Simon N. Patten, of the University of Pennsylvania, who has just published a treatise on "Dynamic Economics." This innocent word, however, which seems to have been to a Russian magnate what a red rag is to a bull, has two things in common with dynamite—a common origin from the Greek, and a common symbolism of power—and could dynamic sociology once find its way under the crust of Russian society and Russian government, its effect, though gradual and peaceful, would be more thorough and complete than that which all the dynamite bombs in the world, if similarly applied, could produce.

August, 1892—Ætat. 51.

312. The Plant-bearing Deposits of the American Trias.—Abstract

History—Written Aug. 3, 1891. This was the abstract, submitted as required by the rules, of my extended paper with the same title, read by title only, at my request, on Aug. 21, and in full before the Geological Society of America on Aug. 24 (see *supra*, p. 306). The abstracts of all my papers were prepared in duplicate, and one copy given to the Secretary at the meeting. The other was sent to *Science* on Nov. 11. They of course appeared much earlier in *Science* than in the Proceedings of the Association. Nevertheless, I recognize the Proceedings of the American Association as the primary source of the article. The same remark applies to the three following articles.

Proceedings of the American Association for the Advancement of Science, Washington Meeting, 1891, Vol. XL, Salem Press, 1892, pp. 287-288;
Science, New York, Vol. XVIII, No. 459, Nov. 20, 1891, pp. 287-288.

August, 1892—Ætat. 51.

313. Principles and Methods of Geologic Correlation by means of Fossil Plants. —Abstract

History.—Written Aug. 3, 1891. This is the abstract of the extended paper of the same title, read on Aug. 21 (see *supra*, p. 305). See the last title.

Proc. A. A. A. S., *ibid.*, pp. 288–289; *Science*, *ibid.*, p. 282.

August, 1892—Ætat. 51.

314. The Science and Art of Government

History.—Written July 30–31, 1891. Although this is called an abstract it is all that I wrote on the subject, and when read before Section I on Aug. 20, I simply read the abstract and then made a few comments. It was sent to *Science* on Nov. 11, and as in the preceding case, it appeared there long before the Proceedings were issued. Mr. Long got hold of it somehow and reprinted it in the *Cleveland Citizen*.

Proc. A. A. A. S., *ibid.*, pp. 420–421; *Science*, *ibid.*, p. 281. The *Cleveland Citizen*, Cleveland, Ohio, Jan. 23, 1892, p. 3.

GOVERNMENT should be looked upon as the business agency of the nation, and the science and art of government are the science and art of conducting this business agency. The various branches of administration have arisen through pressure from without. Everything that the people have demanded to be done with sufficient unanimity

and persistence has been eventually undertaken by the government. One bureau after another has been created by law, placed in charge of proper officers, and conducted to the best of the latter's ability. Most bureaus have grown and expanded in their scope and usefulness. Many have been several times reorganized and the service perfected.

Although the various systems of administrative operation have been largely empirical, devised by men who had little preliminary preparation for the work, improved through the growth and demands of the service, and brought to perfection by thoughtful study of the needs of the public in each individual case, still the whole rests on a rational basis and constitutes a great system of government. The general laws and principles underlying this system constitute a science,—the science of government. The carrying out of these laws and principles is the art of government, and although, as in the case of almost all the practical arts, it was empirically developed, there is no reason to doubt that it will be as greatly improved and perfected by its reduction to a science and its enlightened prosecution as such, as all the other great industrial arts have been since science has been applied to them.

Among the most promising sources of advantage in the scientific method is the comparative study of government operations. While from a very broad point of view all government is the same, when viewed at all in detail, the greatest individual differences are found. Much of this diversity grows out of the natural differences in the conditions of nations, but fully as much is due to the differences in the methods adopted to accomplish the same purpose. Amid all these varying methods there must be great differences in their efficiency. Some are coarse and clumsy while others are precise and refined. There are all the grades that exist in the manifold mechanical devices of the other arts, those which are best being always those which have most thoroughly utilized natural forces, including the social forces.

The scientific study of government would make the comparative study of methods a leading feature with a view to the recommendation of those which under all circumstances are the very best. This is only one out of any required number of illustrations that might be given of the superiority of the scientific method in government.

In the science of political economy the subject of government operations is destined to occupy an increasingly prominent place. It is safe to say that no chair of political economy in an institution of learning has ever taught or attempted to teach the practical workings of public administration—the way in which the business of the nation is conducted. It is impossible to teach this branch of political economy without the means of a direct examination of the different systems of government business as they are conducted by their respective bureaus.

Each great system, such as those of finance, land, patents, etc., etc., would require a course of lectures with repeated visits to the department, inspection of records, books, papers, merchandise, etc. This would require a legal right to prosecute the study in this only practicable way. Nothing short of a national institution, created and authorized by law to teach the science and art of government could successfully carry out this scheme of education. As a safeguard to our institutions, not less than as a means of national progress and enlightenment, no other educational scheme is equal to it in importance.

August, 1892—Ætat. 51.

315. A National University, its Character and Purpose

History.—Written June 25, 1891. As in the last case, this is all that was written or published of this paper. Its further history is also the same. Prof. E. J. James, vice-president of Section I, manifested much interest in it, and the leading idea was subsequently strongly approved by Gov. Hoyt.

Proc. A. A. S., ibid., pp. 421-422; Science, ibid., pp. 281-282.

THE National University recommended by Washington, Jefferson, Madison, and many later presidents and statesmen is almost certain to be realized in the near future.

It is the object of this paper to offer some hints as to what ought to be its character and purpose.

In the first place it should be distinctively *national*, the creature of the American people and devoted to their use and needs. To this end it should be located at the seat of government and should be exclusively the product of the federal government. It should also be in the fullest sense representative, as is the government itself. Its scholarships should be held entirely by Americans, and should be distributed with local uniformity throughout the entire domain of the United States. Recognizing the intellectual homogeneity of the whole American people, it should have representatives from every section of the country. This could probably best be secured by allotting a given number of scholarships to each congressional district on the basis of representation as determined by the census enumeration. Candidates should be admitted by competitive examination held by the faculty or an examining board appointed by the faculty,

to be absolutely free from all political influence. As the intellectual homogeneity of the American people relates to *capacity* and not to attainment, in order to secure such universal representation, the university should be accompanied by a preparatory department, and those who pass the examination for the university should have no advantage over those who pass for the preparatory department, except that if a sufficient number pass for the former, examinations for the latter need not be held. Candidates who enter the preparatory department should be given precedence over those from the same district at the end of that course for admission to the university.

The faculty should be chosen by a commission consisting of the most eminent scholars and scientific men in the country who are entirely above personal and political bias, such, for example, as the National Academy, the board of Regents of the Smithsonian Institution, and other high authorities in the leading departments of learning.

While the institution should be a university in the fullest and widest sense, it should differ from all other universities in one important respect. All universities have their strong chairs, and many rest their reputation on some one leading feature. The leading feature and true reason for being of the national university should be its course of instruction in the science and art of government. This course should differ radically from the usual courses in political economy and political science. These should not be neglected, but, in addition to them and of higher rank should stand, as the basis of university instruction, a thorough and exhaustive course in the practical workings of government itself. Viewing government as the great agency for the transaction of the people's business, every department of government business should be fully taught both in its principles and its practice, so that the graduate from the national university should come forth in full possession not only of all that constitutes true statesmanship, but also of the practical details of each of the many great business operations which the government undertakes and carries on.

The administrative offices of the government should be filled as soon as possible from graduates of the university, so that at length the civil service force of the United States should consist exclusively of persons who have had a thorough training in the theory and practice of government.

August 30, 1892—Ætat. 51.

316. Notice of the Paleontology of the Cretaceous Formation on Staten Island. By Arthur Hollick. Reprint from Trans. N. Y. Acad. Sci., Vol. XI, 1892

History.—Written Aug. 3-5, 1892.

The American Journal of Science, New Haven, Third Series, Vol. XLIV, [Whole Number CXLIV], No. 261, September, 1892, p. 259.

August 30, 1892—Ætat. 51.

317. Notice of Untersuchungen über fossile Hölzer Schwedens; von H. Conwentz. Kongl. svenska Vetenskaps-Akademiens. Bandet XXIV, No. 13

History.—Written July 29-Aug. 5, 1892.

Ibid., p. 260.

September 10, 1892—Ætat. 51.

318. Weismann's New Essays*

History.—Written Sept. 2, 1892. Some time in June, 1892, Mr. Aydelotte, Editor of *Public Opinion*, gave me the new volume of Weismann's essays and asked me to review it. I was in the field during most of June and read it after my return (July 19 to Sept. 2). As I was saturated with the subject the writing of the review was but the work of an hour.

Public Opinion, Washington and New York, Vol. XIII, No. 23 [Whole Number 335], September 10, 1892, p. 559.

THIS is a much smaller volume than the first and consists of four essays only. The first, on "Retrogressive Development in Nature," is quite elementary, but calculated to illustrate the law of *Panmixia* or universal crossing. The second, on the "Musical Sense in Animals and Man," is an attempt by the use of a single illustration to answer the objection raised by Wallace and others to Weismann's doctrine of the non-transmissibility of acquired characters by showing that there are faculties which seem to have developed and attained an advanced stage which are manifestly of no use in the struggle for existence, and therefore must depend upon something besides natural selection. Weismann admits the premises, but is driven to denying that the capacity for music in man has ever increased, and to attributing all progress in music to cultivation alone. His arguments are specious and furnish as good an illustration as need be sought of the lawyer's method of making the worse appear the better reason. The remotest ancestors of the present most musical races had exactly the same talent for music as their modern descendants. This much he boldly affirms, carrying

* *Essays Upon Heredity and Kindred Biological Problems.* By Dr. August Weismann. Vol. II. Edited by Edward B. Poulton and Arthur E. Shipley. Authorized translation. Oxford, 1892. \$1.30. New York: Macmillan & Co.

it back to barbarism and savagery. But as a thorough-going evolutionist he should not, as he does, stop here, but should insist that the same is true of the animal ancestors of man, not merely the apes but the progenitors of the apes and on down to the base of the vertebrate scale, to the amphioxus and the worms! This *reductio ad absurdum* cannot be escaped. The third essay, entitled "Remarks on Certain Problems of the Day," is chiefly a reply to Professor Vines, who has severely criticised his doctrine of the immortality of unicellular organisms. He is compelled to abandon many of his earlier propositions, but this is decidedly to his credit.

The concluding essay, which occupies more than half the volume, is entitled "Amphimixis, or the Essential Meaning of Conjugation and Sexual Reproduction." It consists principally in an interpretation from the standpoint of Weismann's whole philosophy of some recent important observations, chiefly by Maupas, on the real character of conjugation in Infusoria. The facts themselves lead us deep into the inner secrets of life. Conjugation is not, as was formerly supposed, the mere fusion of two similar homogeneous bodies, but is a complicated process strictly homologous to all appearances, with the union of sperm and germ cells in fecundation and fertilization as it goes on in the higher organisms. The term *amphimixis* is used to embrace both these—*i. e.*, the union of two individuals, either in their entirety or through specialized cells set apart for the purpose. Weismann's generalizations from this fundamental fact are of the highest interest. He claims that amphimixis has essentially nothing to do with reproduction, conjugation reducing instead of increasing the number, and he argues that it is the result of natural selection in striving to produce variety by the union of different hereditary tendencies in the offspring. Sex is merely a means to this end and in itself quite unessential.

October, 1892—Ætat. 51.

319. Notice of Albirupean Studies; by P. R. Uhler. Trans. Md. Acad. Sci., 1892, pp. 185-201

History.—Written Aug. 3-5, 1892.

The American Journal of Science, New Haven, Third Series, Vol. XLIV [Whole number CXLIV], No. 262, October, 1892, pp. 333-334.

October, 1892—Ætat. 51.

320. Notice of the Fossil Flora of the Bozeman Coalfield; by F. H. Knowlton, Proc. Biol. Soc., Washington, Vol. VII, July, 1892, pp. 153-164

History.—Written Aug. 4-5, 1892.

Ibid., p. 334.

October, 1892—Ætat. 51.

321. Notice of Paléontologie Végétale (Ouvrages publiés en 1890), par R. Zeiller. Extrait de l'Annuaire Géologique Universel, Tome VII, 1890, pp. 1115-1157, Paris, 1892

History.—Written July 30-Aug. 5, 1892.

Ibid., pp. 334-335.

October, 1892—Ætat. 51.

322. Notice of Sylloge Fungorum Fossilium hucusque cognitorum. Auctore A. Meschinelli. Patavii, 1892

History.—Written July 28–Aug. 5, 1892.

Ibid., p. 335.

October, 1892—Ætat. 51.

323. Notice of I Tronchi di Bennettitee dei Musei Italiani. Notizie storiche, geologiche, botaniche; dei Professori Senatore G. Capellini e Conte E. Solms-Laubach. Con cinque tavole, Bologna, 1892. Estratta dalla Serie V, Tomo II delle Mem. Real Accad. Sci. Ist. di Bologna

History.—Written Aug. 2–5, 1892.

Ibid., pp. 335–336.

October, 1892—Ætat. 51.

324. Notice of a memoir Ueber den gegenwärtigen Standpunkt unserer Kenntniss von dem Vorkommen fossiler Glacialpflanzen. Von A. G. Nathorst. Bihang till svenska Vet. Acad. Handlingar. Band XVII, Afd. III, No. 5. Stockholm, 1892

History.—Written July 28–Aug. 5, 1892.

Ibid., p. 336.

December, 1892—Ætat. 51.

325. [Appreciation of Childhood.]

History.—From a letter written on July 16 to Florence Hull. See the next paper.

Childhood, A Monthly Magazine of all that concerns the Welfare of the Child, New York, Vol. I, No. 1, December, 1892, p. iv.

PROF. LESTER F. WARD.

I am glad there is a prospect of having a journal devoted to the consideration of the serious questions relating to children, and intended to awaken thought on the subject, and not merely to amuse.

December, 1892—Ætat. 51.

326. The Reciprocal Obligations of Parents and Children

History.—Written Aug. 9–12, 1892. On July 8, 1892, I received a letter from Florence Hull, stating that she and Dr. Winterburn were about starting a new magazine to be called “Childhood,” and inviting me to contribute to it, offering to pay me at the rate of \$10 per 1000 words. I replied on the 16, proposing the above title for the first article, and congratulating the editors on their new enterprise. This last was used as a puff (see the last title). I did not give, as is my custom, the reference to the passage quoted at the head of this article from George Eliot, the reason probably being that the only source I know for it is Cross’s citation in the Appendix to Vol. I of the *Life and Letters*, p. 410, in which he does not himself refer to any of her works. It seems to be his recollection of what he had heard her say.

Childhood was of course ephemeral, but I contributed other articles, Dr. Minot J. Savage contributed one, and upon the whole the journal was creditable and useful.

Ibid., pp. 9–11.

GEORGE ELIOT, who probably has uttered more home truths than any other writer, says:

“There may be conduct on the part of a parent which should exonerate his child from further obligation to him; but there cannot be action conceivable which should absolve a parent from obligation to serve his child, seeing that for that child’s existence he is himself responsible.”

This is the keynote of a great change which is taking place in public opinion relative to the obligations of parents to children.

Until quite recently the universal practice has been to dwell upon the unlimited debt of gratitude that all children owe to those who have brought them into existence. Filial piety is the leading doctrine of one of the greatest religions of the world, that of Confucius. It enters into the Jewish religion as one of the ten commandments, and in one form or another it pervades all religions and all ethical codes. But little or nothing is to be found concerning the reciprocal obligations that flow from the parent to the child. Most governments and laws are founded on the idea that no such obligations exist. Not merely in savage races has the parent the power of life and death over his child; the civil law, as is well known, gave to parents the right to take the lives of their children. In the common law of England, as expounded by Blackstone, parents are not obliged to support their children and may disinherit them, and there are judicial decisions to the effect that a father is not under any legal obligation to educate his children. In fact, the relation between parents and children in the common law is simply and avowedly that between master and servant.

A visitor from another planet, unacquainted with the kind of logic that prevails on this one, judging from the unanimous sentiment of mankind expressed in all these various ways—in law, in literature, in maxims and precepts, and in daily conversation—would naturally conclude that the juvenile members of society were all guilty of some crime against the adult members by which they had placed themselves in the position of Mexican peons, and for which they owed their parents at least fifteen years of personal service and a life of devotion. A child is not a philosopher, but there is no doubt that there exists somewhere in the thinking apparatus of many a young life a feeling, perhaps unuttered and unconscious, that something is wrong. Though incapable of expressing this feeling, they are equally incapable of arresting the reasoning process, which is the same in the child as in the adult except that it is unsophisticated, and this process goes on and works up the materials that it possesses, and builds of them the character of the future man or woman.

There can be nothing worse for human character than that there should be ever present to the developing mind something that it feels must be false, something suggestive of pretence or hypocrisy, something that is suspicious, hollow, or unsound. The perpetual inculcation of the prevailing idea as to the one-sidedness of the obligation between parents and children is demoralizing, in that the child instinctively feels that in fact it is not one-sided but mutual. The child knows that its parents should share the responsibility for its imperfections, and therefore when censured it feels that part of the blame properly and naturally belongs to them. I have known a boy who, when whipped by his father and told that he was "a good-for-nothing

plague and did not earn his salt," would hiss back into the teeth of his irate parent: "You made me so." And doubtless a large share of the escapades and other irregularities of children are due to a righteous sense on their part that they are really wronged by their parents, and punished for possessing natures which they have had no part in creating, but which they have inherited from those who are seeking to shirk their own responsibility.

Without entering into the old question whether life is worth living, which is the same as the question whether to give life is a good or an evil to the life given—a question which no parent has the right to declare settled for his or her children—let us see how the case really stands. How many children are the result of a deliberate purpose on the part of their parents to do good by adding another life to an assumed happy world? If there are any such they could probably be counted on the fingers. If the continuation of the race depended upon any such rational deliberation it would last just one generation. The perpetuation of the race depends upon an instinct, or rather upon two instincts, both of which belong to all higher animals in common with man. For the parental instinct, especially the maternal, is highly developed in all creatures that must in any way care for their young, and in many birds and other animals there is a paternal instinct as strong as in man.

It follows then that, except in a certain biological sense, reproduction throughout the world is purely egoistic and not at all altruistic. It is carried on in response to, and for the satisfaction of, these instincts of the parents, and in these benefits children have no share. It may be said, and truly, that the instincts are irresistible, but if so, the less likely is it that any resulting evil will balance so great a good. If it be said that for a long series of years parents are compelled to make heavy sacrifices in health, time, money, and anxiety for their dependent offspring, the proper answer is that in return for this that dependent being has been at work every day and hour in contributing to the happiness of its parents by the ceaseless gratification of one of the strongest, as well as one of the purest and noblest of passions. And when the age of dependence is past, the account ought to be square between parent and child. Neither before nor after that date is the child under the least obligation for the mere fact of its existence. The account is one which constantly balances itself, the parent and the child are, in this respect, at all times in a condition of perfect equality, and there should be no attempt on the part of the former to create a sense of dependence on the part of the latter. Such attempts, almost universal in society, produce disaffection in families and lead to some of the most serious evils of domestic life.

Only when the whole notion of inequality and subordination,

of master and servant, of debtor and creditor, and of rights and duties, other than as between equals, is completely done away, will there be room for those higher and better sentiments of mutual respect and parental and filial affection to spring up spontaneously and endure perpetually.

December (?), 1892—Ætat. 51.

327. Administrative Report for [the year ending June 30,] 1890

History.—Written June 26–July 1, 1890.

Eleventh Annual Report of the U. S. Geological Survey, 1889-'90, Part I, Washington, 1891 [appeared in 1892], pp. 114–123.

January (?), 1893—Ætat. 51.

328. Report on the Department of Fossil Plants in the U. S. National Museum for the year ending June 30, 1890

History.—The Division of Botany of the U. S. Department of Agriculture was this year transferred to the U. S. National Museum. The entire collection was subsequently brought over and my own collection was incorporated with the rest and thus lost its identity. The idea seemed to be at first to include the Department of Fossil Plants under the general Department of Botany, but this was not continued. The Botanist had nothing to do with the fossil plants, and I continued to make out annual reports upon them, but ceased to do so for recent Plants. These reports were usually prepared by an assistant and revised by me. They were also signed, but in the present case the signature is omitted.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1890. Report of the U. S. National Museum, Washington, 1891 [appeared in January, 1893], pp. 41–42.

329. Bibliography for the eighteen months from January, 1885 to June, 1886, and for the year ending June 30, 1890.

History.—Written Oct. 23–27, 1890. I neglected to furnish my bibliography for the first of these periods when it could have been published in the appropriate volumes. The omission was discovered and supplied in this report.

Ibid., pp. 712–715.

LESTER F. WARD.* Why is water considered ghost-proof?

Science, v, January 2, 1885, p. 2.

The suggestion is made that the wide-spread belief among savages that "water is impassable to spirits" may be due to the obstacles it presents to dogs in pursuing their prey, tracking their masters, etc.

—— A glance at the history of our knowledge of fossil plants.

Science, v, January 30, 1885, pp. 93–95.

Brief review of the progress of Paleobotany from the earliest times.

—— Fontaine's older Mesozoic flora of Virginia.

Science, v, April 3, 1885, pp. 280, 281.

Review of that work.

—— Lesquereux's Cretaceous and Tertiary flora.

Science, v, April 24, 1885, pp. 348, 349.

Review of that work.

—— Premature appearance of the periodical cicada.

Science, v, June 12, 1885, p. 476.

Letter to *Science* recording the hearing of the note of the periodical cicada on October 12, 1884, with an attempt to account for the phenomenon.

* Mr. Ward's Bibliography from January, 1885, to June, 1886, was omitted from the reports of the National Museum. It is supplied here in connection with that for the year ending June 30, 1890.

— The ginkgo-tree.

Science, v, June 19, 1885, pp. 495-497.

An account of the discovery of the flowering for the first time of two ginkgo-trees in the U. S. Botanic Garden at Washington, followed by remarks on the character and distribution of this tree and its paleontological history. Two of the illustrations are of specimens collected by the writer.

— Evolution in the vegetable kingdom.

American Naturalist, xix, July, August, 1885, pp. 537-644; 745-753.

This article discusses the progress that has been made in our knowledge of the laws of development in the vegetable kingdom, considering the subject from the three-fold point of view: its chronological, geological, and botanical history. The second and third parts of the paper are the same as read at the American Association for the Advancement of Science at Philadelphia, September 8, 1884. The first part is an expansion of the corresponding portion of that paper.

— Historical view of the fossil flora of the globe. Geological view of the fossil flora of the globe. Botanical view of the fossil flora of the globe.

Proc. Amer. Assn. Adv. Sci., xxxiii, September, 1884, pp. 493-497.

Abstract of papers read before section F, September 8, 1884.

— A convenient system of river nomenclature.

Science, vi, October 9, 1885, pp. 321-322.

Suggests the giving of monosyllabic names to the tributaries of rivers and of combining these to form the names of the streams which the tributaries unite to form, after the analogy of the Mattapony in Virginia.

— Moral and material progress contrasted.

Transactions of the Anthropological Society, iii, 1884-1885, pp. 121-130 (136).

An argument for conscious activity on the part of society in seeking its own welfare, by showing that the moral condition of mankind has not kept pace with material progress in which such conscious activity has been exercised by individuals.

— An example in political science.

The Daily Telegraph (New York), November 3, 1885, p. 4.

A scientific treatment of the tariff question.

— Mind as a social factor (Abstract).

Transactions of the Anthropological Society of Washington, iii, 1885, pp. 31-32.

The paper was published in full in *Mind* (London), ix, October, 1884, pp. 563-573, and is mentioned above under that date.

— Remarks on Mr. H. H. Bates's paper on "Discontinuities in Nature's Methods."

Transactions of the Anthropological Society of Washington, iii, 1885, pp. 53-54.

Welcomes the introduction of the physical term *discontinuities* into biology in the sense given to it by Mr. Bates, *i. e.*, not implying actual breaks in the series, and offers additional examples.

— Remarks on Prof. J. M. Gregory's paper on the "Elements of Modern Civilization."

Transactions of the Anthropological Society of Washington, III, 1885, pp. 63-64.

Approves the classification of social activities proposed by Professor Gregory, and shows that it is substantially the same as that elaborated by the speaker and published three years before (*Science*, October 23, 1880, pp. 210, 211), and then in press as part of Chapter VII of his forthcoming work on dynamic sociology.

— A National University.

Science, VI, December 18, 1885, p. 539.

Letter approving Secretary Lamar's recommendation of the establishment of such an institution by the Government at Washington.

— Administrative Report of the Chief of the Division of Paleobotany, U. S. Geological Survey, for the year ending June 30, 1884.

Report of the U. S. Geological Survey, 1883-1884, pp. 55-59.

— Sketch of Paleobotany.

Report of the U. S. Geological Survey, 1883-1884, pp. 357-452. Pl. LVI-LVIII.

Gives an historical review of paleobotanical discovery with profuse bibliographical references, a sketch of the history of paleobotany down to the year 1850, an account of the present state of the science, remarks on the nomenclature of fossil plants, a review of the progress toward a natural method of botanical classification, especially as indicated by paleophytology, and a geognostico-botanical view of the plant life of the globe, past and present, illustrated by a tabular exhibit and three diagrams, one of which is colored.

— Notes on the flora of Eastern Virginia.

Botanical Gazette, XI, February, 1886, pp. 32-38.

The more striking changes that occur in the flora on traveling southward from Washington, D. C., to Weldon, N. C., are pointed out and commented upon.

— Moral and material progress.

The Capital (Washington), March 28, 1886, p. 4.

Abstract of the paper above noticed on moral and material progress contrasted.

— On the determination of fossil dicotyledonous leaves.

Amer. Jour. Sci., XXI, May, 1886, pp. 370-375.

Contains a brief review of the progress made in this line of research preparatory to the nomenclature proposed by Nathorst in a recent paper which analyzed and criticised. (Papers published during 1889-1890.)

— The sociological position of protection and free trade.

The American Anthropologist (Washington), II, October, 1889, pp. 289-299.

Argues that protection can be theoretically defended as resting upon the progressive principle of invention, free trade representing the absence of any social effort to improve the commercial and industrial condition.

— Fortuitous variation. Being an abstract of a paper thus entitled, read before the Biological Society of Washington, December 15, 1888.

Nature (London), XL, July 25, 1889, p. 310.

The full title of the paper, as orally presented with exhibition of speci-

mens and comments thereon, was "Fortuitous Variation as illustrated by the Genus *Eupatorium*." The variations in the leaves of the different species of this genus were held to be such as could not all be produced by natural selection, obviously not being specially advantageous to the plant. It was argued that they were fortuitous in the proper scientific sense of that word: *i. e.*, they were the result of the universal pressure of organic life in all directions and represented those directions in which such pressure had been successful, the lines of least resistance.

— Causes of belief in immortality.

The Forum (New York), VIII, September, 1889, pp. 98-107.

The great prevalence of this belief is claimed to be the result of natural causes operating upon primitive man, resulting in a universal notion of spirit, and the chief of these natural causes are enumerated.

— Jurassic plants from Kaga, Hida, and Echizen (Japan).
By Matajiro Yokoyama.

American Journal of Science, XXXVIII, Ser. 3, November, 1889, p. 414.

Brief notice of a paper by the above title in the *Journal of the College of Science, Imperial University of Japan*, III, Pt. 1, Tokio, Japan, 1889.

— The Tertiary flora of Australia. By Dr. Constantin, Baron von Ettingshausen. English translation edited by R. Etheridge, jr., Sydney, 1888.

American Journal of Science, XXXVIII, Ser. 3, December, 1889, p. 493.

Brief notice of a paper with the above title, referring to a fuller analysis of the original memoirs to appear in the Eighth Annual Report of the U. S. Geological Survey (pp. 812-814).

— Contribuzioni alla flora fossile dei terreni terziarii della Liguria. By S. Squinabol. I. Fucoidei ed Elmintoidee, Roma, 1888; II. Caracee-Felci, Genova, 1889.

American Journal of Science, XXXIX, Ser. 3, January, 1890, pp. 72, 73.

Brief notice of papers with the above titles published by the Italian Geological Society and University of Genoa.

— Administrative Report to the Director of the U. S. Geological Survey for the year ending June 30, 1887.

Eighth Annual Report of the U. S. Geological Survey, 1886-1887, Pt. I, 1889, pp. 184-189. Issued February, 1890.

— The geographical distribution of plants.

Eighth Annual Report of the U. S. Geological Survey, 1886-1887, Pt. II, 1889, pp. 663-960, Pl. LXI, issued February, 1890.

An extended and detailed enumeration of the localities at which fossil plants have been found, the works mentioning them, and the age of the deposits in which they occur; arranged primarily in a geographical order beginning with England and ending with the United States, with a map of the United States showing the localities and formations.

— The course of biologic evolution. Annual Address of the President of the Biological Society of Washington, delivered January 25, 1890.

Proc. Biol. Soc. of Washington, v, 1890, pp. 23-55; Pamphlet, pp. 1-33.

The fundamental and distinct modes or lines of development are recognized, the normal and the extra-normal. In both, evolution takes place chiefly through the law of the extinction of trunk lines of descent, coupled with that of the persistence of unspecialized types. Normal development

is illustrated in the vegetable kingdom, the principal steps being the origin of exogeny, phenogamy, gymnospermy, angiospermy, exogenous angiospermy; and the development of floral envelopes, apetal, polypetal, gamopetal. Extra-normal development is illustrated by fortuitous variation, in general by the origin of showy and fragrant flowers, and of bright-colored and sweet-flavored fruits. The abnormalities of sex as produced by both female and male selection are explained. Finally it is shown that all extra-normal development is the result of the origin and growth of the psychic element.

- On fossil plants collected by Mr. R. A. McConnell, on Mackenzie River, and by Mr. T. C. Weston, on Bow River. By Sir J. W. Dawson.

Amer. Jour. Sci., xxxix, Ser. 3, May, 1890, p. 406.

Notice of a paper with the above title.

- Report on the Department of Fossil Plants in the U. S. National Museum, 1886.

Report of the Smithsonian Institution, II, 1886 (1889), p. 231.

- Report on the Department of Recent Plants in the U. S. National Museum, 1886.

Report of the Smithsonian Institution, II, 1886 (1889), pp. 233-235.

- Report on the Department of Fossil Plants in the U. S. National Museum, 1887.

Report of the Smithsonian Institution (U. S. National Museum), 1887 (1889), pp. 145, 146.

- Report on the Department of Recent Plants in the U. S. National Museum, 1887.

Report of the Smithsonian Institution (U. S. National Museum,) 1887 (1889), pp. 145, 146.

- Remarks on Dr. Newberry's paper on the Laramie Group, at the Geological Society of America in New York, December 26, 1889.

Bull. Geol. Soc. Amer., I, 1890, pp. 529-532.

These remarks relate chiefly to the position which Fort Union beds occupy relatively to the original Laramie deposits of Colorado and Wyoming.

- Remarks on Mr. David White's paper on Cretaceous plants from Martha's Vineyard, at the Geological Society of America in New York, December 28, 1889.

Bull. Geol. Soc. Amer., I, 1890, pp. 555-556.

Pointing out especially the importance of Mr. White's discoveries to geology in settling beyond further dispute the age of a certain portion at least of the Gay Head section, which has been the subject of geological investigation for a century, and was still enshrouded with doubt.

- Genius and woman's intuition.

The Forum (New York), IX, June, 1890, pp. 401-408.

This article is a reply to one by Grant Allen on woman's intuition, in the preceding number of the Forum. It aims to give a scientific explanation of the origin and nature of the well-known faculty by which most women are able to arrive instantaneously and correctly at the decision of certain

questions of practical life, and point out what these questions are and their limitations, thus denying the implication in the article reviewed that the faculty is general or occult. It refutes the claim of Mr. Allen that there is any analogy between this power and that of true genius, and shows that the two faculties are distinctly antagonistic, the former being essentially practical, while the latter is essentially ideal. Mr. Allen's theory that men of genius are the sons of women in whom the intuitive faculty is highly developed is shown to be erroneous, the popular view being that they are the sons of women of intellectual superiority. The conclusion is drawn that the chief desideratum is the intellectual development of women.

— The Potomac or younger mesozoic flora; by William Fontaine.

Amer. Jour. Sci., xxxix, Ser. 3, June, 1890, p. 520.

Notice of the work of the above title being Monograph No. XV of the U. S. Geological Survey Washington, 1889.

January 10, 1893—Ætat. 51.

330. Geographic Nomenclature of the Rock Creek Region

History.—Written Nov. 21–25, 1892. In 1892 the Commissioners of the District of Columbia requested the Anthropological Society of Washington to assist them in selecting names for the streets of the rapidly expanding city, and of various physical features of the District of Columbia. A committee was appointed by the Society of which Mr. James Mooney of the U. S. Bureau of American Ethnology was made chairman. I was a member of the committee and attended its meetings. On Nov. 15 this was made the subject of a regular meeting of the Society, and in the discussion I recommended the adoption of euphonious Indian names and of certain names that I had used in my "Guide to the Flora of Washington and Vicinity," and had introduced into the map that accompanies that work. I was asked to prepare a list of these latter, and this report was the result. It was sent in on the 29th and parts of it were incorporated in Mr. Mooney's general report on the "Geographic Nomenclature of the District of Columbia." Reports made by other members of the committee were similarly condensed and embodied in his general report which was ratified and adopted as the report of the Society, signed by the five members of the committee, and published in full in the *Anthropologist* for January, 1893 (pp. 29–52). On page 43 Mr. Mooney says:

"A few of the streams within the District have recognized names which may well stand, only making the designation conform to the system indicated, where this is not already the case. A number of others have been named by Prof. Lester F. Ward in accordance with their botanic or physical characteristics, and some of these names appear on a map printed with his work on the District flora, published by the Smithsonian in 1881. Many of them are in every way

appropriate and may well be adopted. For other streams names may be selected from the lists herewith appended. It might be well also to commemorate in this manner some of the early explorers of the region when the names are sufficiently distinctive."

On page 45 he inserts my nomenclature of the Rock Creek Region considerably abbreviated. This report was issued separately as a pamphlet for the use of the Commissioners of the District and others.

The American Anthropologist, Washington, D. C., Vol. VI, No. 1, January, 1893, p. 45; Geographic Nomenclature of the District of Columbia.

A Report, Washington, D. C., 1893, p. 17.

*Selected Names from Ward's Nomenclature of the
Rock Creek Region.*

Rocket run.—Entering Rock creek from the west a short distance above Oak Hill cemetery. So named from the abundance along its banks of the rocket plant (*Hesperis matronalis*), rare elsewhere in the District.

Conopholis ridge.—A high ridge between two streams entering the creek on the same side a little farther up. So named from the abundance of the *Conopholis Americana*. The English names of the plant, cancer root and squaw root, are obviously inappropriate.

Aralia run.—Farther up on the north side of the creek. From the *Aralia spinosa* or Hercules club found growing here and almost no place elsewhere in the District.

Mitella run.—Entering the creek from the north not far below Woodley Lane bridge. From the abundance of *Mitella diphylla* or Bishop's Cap.

Checkerberry bluff.—On the northwest bank of Rock creek, at the great bend near the Holt house and the present headquarters of the Zoological park. So named from the presence there of the *Gaultheria procumbens* or checkerberry.

Mistletoe valley.—The ravine through which runs the Quarry road, which leads to the principal entrance of the Zoological park. So called from the occurrence of the mistletoe on several of the sour-gum trees growing in it, especially on its southern slope.

Violet ridge.—The gravelly ridge between the two branches of the small stream which enters Rock creek from the east near the entrance to the Zoological park. So named from the abundance upon it of the *Viola pedata* or birdfoot violet.

Valerian bluff.—On north side of the creek, near the upper end of the Zoological park. From the abundance here of the *Polemonium reptans* or Greek valerian.

Cascade run.—“Here the Zoological park ends and the Rock Creek park begins, and the fine stream that comes in from the west is my Cascade run, so named from the cascade that it has formed. This is one of the finest natural cata-racts in the Rock Creek region.”

Poplar bottom.—On the left bank, in the bend just below Pierce's mill.

Soapstone run.—A tributary of Broad branch. “From the well-known soapstone quarry” near its head.

Wintergreen ridge.—A ridge or promontory on the north bank of Rock creek near Blagden's mill. From the abundance there of the wintergreen or checkerberry, *Gaultheria procumbens*.

January 16, 1893—Ætat. 51.

331. The Psychologic Basis of Social Economics

History.—Written July 17, to Aug. 7, 1892. At the Washington Meeting (1891) of the American Association for the Advancement of Science, on account of the two papers I read before Section I (Economics and Statistics), I was made Secretary of that Section for the Rochester Meeting of 1892. As the time drew near for the meeting I thought I ought to read a paper before that Section. Mr. S. Dana Horton was the vice-president of that Section, but the work of organizing it had fallen almost wholly upon me, and Mr. Horton, whose wife was very ill in Germany, was finally obliged to give up attending the meeting and go over to take care of her. I had written the bulk of my book, *The Psychic Factors of Civilization*, during the winter and spring, but before I completed the first draft of this article on July 30, I was contemplating its embodiment in that work. Mr. Horton telegraphed his resignation of the vice-presidency on August 3. I had some intimation that I would be made vice-president in his place, but I was not elected until Aug. 17, which was the day on which the Section opened and the address was delivered. Instead of making it a paper before the Section, I made it my address. There was a fair attendance to hear me, including Dr. David Jayne Hill, then president of the University of Rochester, and whose subsequent career is so well known, and Prof. Joseph Le Conte, who was president of the Association. I attended the Chautauqua meeting of the American Economic Association on Aug. 20-27, and while there Dr. Patten asked me to give him my address for the *Annals* of the American Academy of Political and Social Science, and I let him take it. On Oct. 18, he sent me a criticism of it, and said I would have to modify parts of it before

it could appear in the *Annals*. They were not willing to publish my list of "paradoxes." Prof. F. W. Putnam, Permanent Secretary of the A. A. A. S., was at that time hurrying me to send him the manuscript of my address for publication in the *Proceedings* and I wrote to Dr. Patten to return my manuscript, which was soon done, and I sent it to Professor Putnam. I supposed that ended it so far as the *Annals* were concerned, but on Nov. 25, I received a letter from Professor E. J. James saying that he wanted the address for the *Annals* immediately. I had my original draft, and I struck out the parts objected to and sent it on. It appeared almost simultaneously in the *Proceedings* and the *Annals*, for although the volume (XLI) of the former bears date, 1892, it did not reach me till January, 1893, my reprints arriving on the 16, and those from the *Annals* on the 30, but the January number came on the 7.

On Sept. 15, 1892, I commenced re-elaborating the whole article and adapting it to my book, *The Psychic Factors of Civilization*, changing the title to: *The Economy of Nature and the Economy of Mind*, which is that of Chapter XXXIII and opens Part III of that work.

Mr. Edward Bellamy was at that time issuing his *New Nation*, and I had been a subscriber from the first, though I had had no correspondence with him. I had sent him my *False Notions of Government* (see supra, p. 64) and other things of mine that I considered to be somewhat in his line of thought, and I sent him this address. I received the following letter from him.

"THE 'NEW NATION,' 13 WINTER STREET, BOSTON,
"Jan. 25, 1893.

"MR. LESTER F. WARD:

"I have just read your altogether admirable address (kindly sent me by yourself) upon 'The Psychologic Basis of Social Economics,' and cannot refrain from congratulating you upon so masterly a statement. It would be extremely beneficial to the cause of social reform if some way could be devised to give it general circulation.

"Sincerely yours,

"EDWARD BELLAMY."

Mr. Bellamy did what he could in the direction of this letter, by publishing the greater part of the address in the *New Nation* for April 22, 1893. He there called it *Psychologic Basis of Nationalism*, and correctly states its source. He prefaced the article with these words:

"Our readers will do well to read somewhat carefully the article reprinted in the present number from Lester Ward. It will bear study as furnishing the best of ammunition for replying to the 'survival of the fittest' argument against nationalism."

Of course I received many letters of strong commendation of the address, some of them from persons of distinction and a few of them going to the merits of the questions discussed. I will give one only, not as a sample of the whole, but as the one which afforded me the greatest satisfaction:

"LEGATION OF THE UNITED STATES,

"ST. PETERSBURG, March 31, 1893.

"DEAR MR. WARD:

"Accept my sincere thanks for a copy of your address at Rochester on the 'Psychologic Basis of Social Economics.' It has greatly interested me as a brilliant and successful effort to show the weak basis of the whole *laissez faire* system.

"While I am not sure that I can arrive easily at all your conclusions, I am greatly impressed by the whole line of argument, starting especially from your beginning in pointing out a firm developmental source of error in the dominant system, and ending with your summing up on page 320.

"I have long been convinced that, while the *laissez faire* theory rendered good service by clearing the modern world of the worst in the cumbrous system of the last century, it is utterly inadequate as regards the great problems now pressing upon the world.

"Nothing is more touching than to see the doctrinaires regarding this system as a sort of divinely revealed mass of truth. Your address will do much to set men thinking in a better way.

"With renewed thanks I remain,

"Very sincerely yours,

"AND. D. WHITE.

"TO LESTER F. WARD,

"Washington, D. C."

In *Public Opinion* for Jan. 28, 1893, there is an extract from this address under the title: *Nature's Waste of Life Force*, consisting of the treatment of biologic economics on pages 302-304. Other journals quoted parts of it, and there were some attempts to review it.

There is one matter that I have always associated with this paper, and as this is to a large extent a biographical work, I am going to say what I think, even though it may sound egotistical.

I have searched in vain for any clear expression of the leading ideas of this address anterior to its delivery on Aug. 17, 1892. I had uttered some of them in my *Dynamic Sociology*, and

especially in my article in *Mind*, entitled: *Mind as a Social Factor* (supra, Vol. III, No. 179, p. 361), but I had not formulated them systematically. No one else had so much as hinted at them, to my knowledge. The most important thought is that of the diametrically opposite methods of nature and of man or mind—the genetic and the telic methods. Now the fact that I wish to draw attention to is that Professor Huxley in his Romanes lecture, delivered on May 18, 1893, and especially in his *Prolegomena* to it, written in 1894, deals with this subject and sees it in the same light as I do. Even his illustration (his garden) is almost exactly the same as mine, given on page 308. About the only difference is that he calls it the “ethical” method, which it is not in any true sense of that word. That doctrine was put forth by him in his *Evolution and Ethics* as an entirely new one, and the world so regards it and gives him the entire credit for having first proposed and defended it. Why should he have happened to conceive such an important idea just at that time? The *Proceedings* of the Rochester Meeting of the A. A. A. S., 1892, were in his hands long before he delivered his Romanes lecture, and he may be assumed to have glanced through them and read such parts as attracted his attention. The addresses of the vice-presidents of the several sections would be the first things to interest him, representing as they do the progress made during the year in all the sciences. With such a mind as Huxley’s one may imagine that the title of my address would specially appeal to him. But even if it be supposed that he failed to note and read the address in the volume, there is another reason for knowing that he could not have been wholly ignorant of its existence. I distributed my 200 reprints in January, 1893, mailing them all on the 22. A card-mailing list, which I have always strictly kept, shows to whom everything I have ever sent out was sent. It shows that this address was mailed to Professor Huxley on that date. I had never corresponded with him and was personally unknown to him, but that would not have prevented him from reading the address of the vice-president of one of the sections of the leading scientific body in America.

Now, I am not saying that Professor Huxley intentionally appropriated my ideas. I am simply saying that the evidence all strongly points to his having been started on that train of thought by the reading of my address. It sometimes happens

that a new idea will make but a slight conscious impression at the time it is first received, but that, being important, an unconscious process will go on and ultimately bring it into great prominence. This has several times happened with me. He might have forgotten where it came from, or even come to suppose it original with him. There are many charitable ways of accounting for apparent plagiarisms. The mind is a subtle and wonderful thing, and many of its ways are "past finding out."

Proceedings of the American Association for the Advancement of Science, Rochester Meeting, 1892, Vol. XLI, Salem, 1892, pp. 301-321; Annals of the American Academy of Political and Social Science, Philadelphia, Vol. III, No. 4, January, 1893, pp. 464 [72]-482 [90]; Publications of the Academy, No. 77; Public Opinion, Washington and New York, Vol. XIV, No. 17 [Whole Number 355], January 28, 1893, p. 403; The New Nation, Boston, Vol. III, No. 16, April 22, 1893, pp. 204-207.

THE object of my remarks this afternoon shall be to emphasize the distinction between that system of political economy which is based upon the actions of the human animal and that system which is based upon the actions of the rational man. The former is the prevailing system of the schools as taught under varying aspects by the physiocrats, Adam Smith, Ricardo and Malthus. Its underlying principles are set forth in the writings of Herbert Spencer and constitute the warp of modern individualism. The latter has from time to time been dimly foreshadowed by certain writers but has never taken any scientific form except in a little known work by the present writer.¹ Although its distorted image is reflected in numerous more or less obnoxious forms from the mirror of public opinion, its real shape is quite unfamiliar to the greater number even of the best informed persons.

Auguste Comte recognized the influence of mind in society and placed psychology where it belongs in his hierarchy of the sciences, but he refused to give it the rank of a science distinct from biology and classed it as a department of that science, calling it "transcendental biology." Nevertheless, in his discussions he gave considerable weight to it, laying stress on the elements of prevision and the control of social phenomena. Spencer, on the contrary, while he treated psychology at length and assigned it the same position that Comte did, failed to make it the basis of either his sociology or his ethics, both of which in his system rest directly upon biology. His psychology, therefore, which, indeed, was written before his biology and largely from the

¹ "Dynamic Sociology." D. Appleton & Co., New York, 1883, 2 vols.

standpoint of metaphysics, stands isolated and useless in his system of synthetic philosophy.

The question is whether the phenomena of social, political, and industrial life rest primarily upon or grow chiefly out of the facts and laws of biology or those of psychology. It became early fashionable, in the name of science, to treat the uniformity and invariability of natural phenomena displayed in the astronomical and physical world, as extending also to animal life including the operations of economic forces in society. The correctness of this view, considered in the abstract, cannot be questioned, but the economists of that time did not sufficiently understand the nature of such complicated phenomena to make them the basis of a political or industrial science. The time has scarcely come as yet when we can do more than carefully feel our way along this obscure path; but the flood of light, which modern science since Darwin has shed upon the whole domain of biology, has not only pointed out the erroneous character of the prevailing mode of reasoning, but has shown at least one, and this the most fundamental source of the error which pervades it. This consists in practically ignoring the existence of a rational faculty in man, which, while it does not render his actions any less subject to true natural laws, so enormously complicates them that they can no longer be brought within the simple formulas that suffice in the calculus of mere animal motives.

While the subject, as thus outlined, is primarily a psychologic one, viz., that of determining the true rôle that mind has played in the industrial history of the race, the question at issue is essentially an economic one. There are two distinct kinds of economics, biological economics and psychological economics—the economics of life and the economics of mind. That is to say, there are two kinds of economy which it is of the first importance sharply to contrast, the economy that prevails in the animal world, in the domain of life, in organic nature generally, and the economy that prevails in the human sphere, in the realm of mind, in the domain of reason.

Every one is now familiar with the general nature of animal economics. It is the survival of the fittest in the struggle for existence. It is the mere physics of life. Just as in the physical world and the great clash of mechanical forces, the superior overcome the inferior and what we see is the resultant product of the struggle, so in the great struggle of life the forms that exist are such and only such as were able to survive the ordeal. But in biology the forces are the various tendencies to grow and develop including animal appetites, wants and desires. These are ever seeking satisfaction, and only their relative feebleness can prevent them from attaining it.

It was formerly supposed that organic nature was economical of its energies. The facts early observed, that every organ is

adapted to some function and that every creature is fitted for the place it inhabits and the life it leads, were supposed to indicate a state of perfect harmony in the entire machinery of nature involving the maximum economy. Such misinterpretations were widely inculcated by optimistic writers and came at length to permeate the thought of mankind. The political economists seized upon them and made them the basis of their systems, and even the great philosophers were and continue to be affected by them. Still, nothing is now better known than that the great biologic law, instead of being economical, is extremely wasteful of energy. It is indeed true that everything that is made by nature is adapted to some function or use. This follows from the genetic method of evolution. Everything that exists is pushed into existence by a *vis a tergo*. Nature only works through efficient causes. The universal life force is perpetually creating new organs and new forms, and these must be adapted to their environment, otherwise they cannot even be brought into being. But this adaptation need only reach the minimum stage. If it is sufficient to insure continuance the end is attained, though higher degrees are always being aimed at. The means, however, through which the world is kept peopled with life are far from being the most economical conceivable. They often seem to be the least economical conceivable. They are just such as all the circumstances of each case combine to produce. The cost of accomplishing a given end is wholly immaterial from a purely biological standpoint. The extravagance of nature has long been perceived even by political economists but they have failed to see that its admission was fatal to their physiocracy. Malthus showed that but for premature deaths, population would increase beyond all bounds, and he also foreshadowed Darwin's law of natural selection by proving that this mortality was really caused by competition and the struggle for existence. We now know that in the animal and vegetable world, but for this wholesale destruction of those that have been born, any one species would soon overrun the earth. But the cost of bringing forth one of these unfortunate beings that are destined to perish at some early period in its history is as great as that of bringing forth one that is to reach maturity and contribute to the perpetuation of the species. Consider then the enormous waste involved in this method over a method which should only bring forth the number necessary to maintain the species at its maximum or desired limit and should preserve all that came into being until they had accomplished their mission. In oviparous creatures the destruction begins with the eggs, and to meet this these are often produced in prodigious numbers. The sturgeon is not an abundant fish, and yet the female spawns a hundred thousand ova. If all these could live one pair would stock all the rivers of America. The number of eggs spawned by a single eel

sounds too fabulous to be believed, while in the lower invertebrate world the figures grow still more astounding, as for example that a tape-worm should possess a billion ova. In the vegetable kingdom we encounter the same class of facts. Burst a puff-ball and the air is filled with smoke, but each element of that cloud consists of a minute spore ready to germinate if by the rarest chance it shall find a suitable habitat. Some one has been to the trouble to determine the number of spores yielded by a plant of the common mould, and reached the incredible figure of three billions two hundred millions. But even among higher plants the same prodigality is seen. A large chestnut tree in June probably contains a ton of pollen, and many pines are equally laden with it, destined to be blown by the winds and floated hundreds of miles in the upper atmosphere. There are also many plants, like the orchid and the broomrape which bear myriads of minute seeds, not one in many thousand of which ever has an opportunity to germinate. These are only a few examples. Everywhere in nature the vital energy is squandered in the most prodigal manner. The amount expended on any one species would, if economized, carry on half the activity of the animal or vegetable world.

✓ No one, so far as I am aware, has attempted to formulate the true law of biologic economics. Much has been said of the law of parsimony which is only a very subordinate one sometimes called into exercise, but of the great law of prodigality, which is universal, no adequate definition has as yet been offered. As the law of life in organic nature does not essentially differ from the law of force in inorganic nature, it may, for the sake of brevity, be designated as *the law of nature*, with which it is important to contrast the psychologic method, or *the law of mind*.

The complete law of nature is capable of being divided into two parts or members. We have seen that it is always directed toward some useful end and that from its very nature as a genetic process it is incapable of producing any necessarily useless thing. Its products must therefore all possess a possible or *potential* value. This part of the law may therefore be expressed by the formula that *every creation of organic nature has within it the possibility of success*. Thus far the biologic law is economical. But, as we have seen, only the minutest fraction of that which is created becomes an *actual* success. The second member of the definition must therefore be framed to express this truth. The principle that underlies it may be called *the necessity for certainty* or *the paramount importance of certainty*. It might also be called *the multiplication of chances*. There seems to be no limit in nature to the degree of energy that may be put forth in the direction of securing certainty. The chances of survival will be multiplied a thousand times in order that certainty may be made a thousand times certain. The second member of the law therefore is

that *in order to secure certainty the chances may be indefinitely multiplied*. The entire law may then be thus formulated: *All energy expended by organic nature results in potential utility and actual utility is secured through the multiplication of efforts*.

The first member of this law may be characterized by the term *practical*. The second member may in like manner be called *prodigal*. Nature is therefore at once the most practical and the most prodigal of all economists: practical in that she never makes anything which has not the elements of utility: prodigal in that she spares no expense in accomplishing even the smallest results. Again, nature may be said to be engaged in creating every conceivable form. Everyone is familiar with the wonderful variety in the actual forms of vegetable and animal life. But these, innumerable as they are, only represent nature's successes. Intermediate between them there must be imagined an infinite number of failures—conceivable forms in the production of which the organic energy has expended itself in vain—a vastly greater expenditure than that required to create all that exists. Moreover, among the successful forms there are all degrees of success. There are the vigorous and robust forms rejoicing in a full measure of vitality and marching forward toward the possession of the earth. Then there are the weak and languishing forms which the former class is gradually crowding out of existence. Between these there are all the intermediate grades. But the successful are only temporarily so. Like human empires they have their rise and fall, and the path of natural history, like that of human history, is strewn with the remains of fallen dynasties and the ruins of extinct races.

If the expenditure of energy be designated the *cost*, then it may be said to be a characteristic of the law of nature to exaggerate the cost of any given result. The most economical way in which a river can flow is in a straight line from its source to its mouth. But even if one were to begin in this way it would, as a result of this principle, soon become crooked and then more and more crooked, until at length the actual distance traversed by every drop of water would be at least double that of a straight line. This physical law, which has been called the rhythm of motion, is carried into the organic world. The tendency is everywhere to exaggerate the irregularities of normal development. This goes on until it frequently results in abnormalities so great that they bring about their own extinction. Such were doubtless the strange dragons that, as paleontology tells us, inhabited the world during a certain geologic period; while the more recent mastodon and mammoth, and those wingless birds of the southern hemisphere, one of which, the moa, once known to man, is already extinct, furnish other illustrations. In the vegetable kingdom the coal flora is full of examples. Many living plants, either through parasitism, as the *Rafflesia*, which consists

almost exclusively of a gigantic flower, or through extreme specialization, as in the orchids and yuccas, many of which are dependent upon a single species of insect which alone has organs adapted to fertilize their flowers, further exemplify this law. Such monstrosities inevitably perish with the slightest alteration in their material surroundings. The progress of organic development has thus been to a large extent the successive creation of types that have contained within themselves the elements of their own extinction. New ones, of course, have succeeded them, adapted for the time being to their environment, but destined in turn to outgrow their conditions and perish from the same cause.

In this sketch of natural or biologic economics its genetic character has thus far been chiefly left out of view, in virtue of which effects are always just equal to causes and never greater. The organic force is applied directly to the object to be transformed, and the forms to be created are molded into the required shape by an infinite number of minute impacts, the sum of which is represented by the transformation accomplished. No advantage is taken of any mechanical principle whereby the effect is made to exceed the energy expended. Natural selection has, indeed, evolved structures that embody to some extent such principles. Sharp teeth and claws like edged tools represent the inclined plane, and it may sometimes be carried so far as to imitate the screw, as in the appliances which some seeds possess for boring spirally into the earth. Again, there is no doubt that the manner in which muscles are attached often affords a true leverage and greatly increases the effectiveness of muscular action. But aside from these curious cases in which natural selection seems to imitate rational design, effect throughout organic and inorganic nature is exactly equal to cause, and the result produced by living beings is proportioned to the effort put forth. No animal, for example, is ever seen to make use of any external appliance, not even to the extent of wielding a weapon, such as a club or a stone, which is not a part of its own organic structure. The beaver, indeed, builds dams by felling trees, but its tools are its teeth and no further advantage is taken than that which results from their sharpness and the way the muscles are attached to the jaws. All the warfare of animals is waged with tooth and nail, with horn and hoof, with beak and spur and fang and sting—always with organic, never with mechanical weapons. And whatever work is done by animals is always done with tools that nature has provided through a long course of development, none of which takes advantage of any principle of physics further than as already stated.

Over against this method of nature, or biological economy, let us now set the method of rational man, or psychological economy. The most patent distinction which at once strikes the mind is that the latter is *teleological* instead of genetic and deals with final

instead of efficient causes. This means that while organic forms are merely pushed into existence by the pelting of atoms from behind, and thus become fortuitous or literally chance products, human creations are conceived in advance by the rational and foreseeing mind, designed with skill for definite ends and wrought with the aid of a variety of mechanical principles by which the energy expended is out of all proportion to, and always less than the result accomplished. It is in rational man, therefore, that the first application of anything worthy of the name of economy is made. Nature has no economy. Only through foresight and design can anything be done economically. If nature produces nothing that may not possibly prove useful, man produces nothing that will not probably be useful. But nature creates many thousand actual failures to one actual success, while man, though he often fails through ignorance, is ever approaching a stage at which every effort shall succeed. His rivers (canals, millraces, irrigation trenches, etc.) are straight, or as nearly so as true economy of construction requires, and Professor Schiaparelli has based his belief that the planet Mars is inhabited by rational beings upon the supposed discovery of great waterways passing across its disk in right lines.

Nature's way of sowing seed is to leave it to the wind, the water, the birds and animals. The greater part falls in a mass close to the parent plant and is shaded out or crowded to death by its own abundance. Only the few seeds that chance to be transported by one agency or another to some favorable spot and have the further good fortune to be covered up can sprout. The most of these even never attain maturity, and only the most highly favored live to continue the race. To meet this enormous waste, correspondingly enormous quantities of seed are produced. Such is nature's economy. How different that of a rational being! He prepares the ground, clearing it of vegetable competitors, then he carefully plants the seeds at the proper intervals, so that they shall not choke one another, and after they have sprouted he keeps off their enemies, whether vegetable or animal, supplies water if needed, even supplies the lacking chemical constituents of the soil if he knows what they are, and thus secures as nearly as possible the vigorous growth and sure fruition of every seed planted. Such is the economy of mind.

A closer analysis shows that the fundamental distinction between the animal and the human method is that *the environment transforms the animal while man transforms the environment*. This proposition holds literally almost without exception from whatever standpoint it be contemplated. It is, indeed, the full expression of the fact above stated that the tools of animals are organic while those of man are mechanical. But if we contrast these two methods from our present standpoint, which is that of economics, we see at once the immense superiority

of the human over the animal method. First consider the economy of time. It has taken much longer to develop any one of the organic appliances of animals, whether for war or industry, than is represented by the entire period during which man has possessed any arts, even the simplest. Look next at the matter of efficiency. Not one of the organic appliances has sufficed to enable the species possessing it to migrate far from the region to which it was originally adapted. Man, on the other hand, without acquiring any new organic adaptations, but by the invention of tools, by providing himself clothing and shelter, by artificial devices for capturing prey, and by other ways of transforming his environment, has placed himself in position to occupy the whole earth from the equator to the arctic circle, and to become the only animal that is not restricted in its habitat.

Every implement of human design is calculated to take advantage of some mechanical principle through which the muscular force necessary to be exerted is less for any given result accomplished than it would be without such implement. In most cases it is many times less, but in the great majority of cases no result could be produced at all without the implement. Machines are simply more effective tools, and it is through tools and machinery that the arts have been established. The utter helplessness of man without the arts is well illustrated by De Foe in Robinson Crusoe, and yet in order to enable him to survive at all, even in a tropical climate where nature's productions were exuberant, he must provide himself from the stores of the wrecked vessel with a considerable supply of tools and other artificial appliances. What was true of Robinson Crusoe thus circumstanced, is much more true of the great majority of mankind who inhabit what we call temperate climates, *i. e.*, climates in which the temperature sometimes falls ten or twenty degrees below the freezing point. One winter without art would suffice to sweep the whole population north or south of the thirtieth parallel of latitude out of existence.

We are so much accustomed to the terms *labor* and *production* that we rarely stop to think what they really mean. Neither of these terms has any place in natural economics. All labor consists in an artificial transformation of man's environment. Nature produces nothing in the politico-economic sense of the word. Production consists in artificially altering the form of natural objects. The clothes we wear are chiefly derived from the sheep, the ox, the silkworm and a few other animals, the cotton plant, flax, hemp, and a few other plants; but between the latest stage at which nature leaves these and the final form in which they are ready for use, the steps are many and the labor great. The dwellings man inhabits once consisted chiefly of trees, clay, and beds of solid rock. These have been transformed by labor performed with tools and machinery into houses. The

same is true of temples and of all the other buildings that now cover the surface of the earth wherever man is found. And so the entire cycle of human achievement might be gone through. All these transformations are accomplished through the arts.

The sum total of human arts constitutes man's material civilization, and it is this that chiefly distinguishes him from the rest of nature. But the arts are the exclusive product of mind. They are the means through which intelligence utilizes the materials and forces of nature. And as all economics rests primarily on production, it seems to follow that a science of economics must have a psychological basis. In fact the economics of mind and the economics of life are not merely different but the direct opposites of each other. The psychologic law strives to reverse the biologic law. The biologic law is that of the survival of structures best adapted to the environment. Those structures that yield most readily to changes in the environment persist. It has therefore been aptly called the "survival of the plastic." The environment never changes to conform to the structures but always the reverse, and the only organic progress possible is that which accrues through improvements in structure tending to enable organic beings to cope with sterner and ever harder conditions. In any and every case it is the environment that works the changes and the organism that undergoes them.

But the most important factor in the environment of any species is its organic environment. The hardest pressure that is brought to bear upon it comes from other living things in the midst of which it lives. Any slight advantage which one species may gain from a favorable change of structure causes it to multiply and expand, and unless strenuously resisted, ultimately to acquire a complete monopoly of all things that are needed for its support. Any other species that consumes the same elements must, unless equally vigorous, soon be crowded out. This is the true meaning of the survival of the fittest. It is essentially a process of competition. The economics of nature consist therefore essentially in the operation of the law of competition in its purest form. The prevailing idea, however, that it is the fittest possible that survive in this struggle is wholly false. The effect of competition is to prevent any form from attaining its maximum development, and to maintain a certain comparatively low level for all forms that succeed in surviving. This is made clear by the fact that wherever competition is wholly removed, as through the agency of man in the interest of any one form, that form immediately begins to make great strides and soon outstrips all those that depend upon competition. Such has been the case with all the cereals and fruit trees; it is the case with domestic cattle and sheep, with horses, dogs and all the forms of life that man has excepted from the biologic law and subjected to the law of mind, and both the agricultural and the pastoral stages of

society rest upon the successful resistance which rational man has offered to the law of nature in these departments. So that we have now to add to the waste of competition its influence in preventing the really fittest from surviving.

Hard as it seems to be for modern philosophers to understand this, it was one of the first truths that dawned upon the incipient mind of man. Consciously or unconsciously, it was felt from the very outset that the mission of mind was to grapple with the law of competition and, as far as possible, to overcome and destroy it. This iron law of nature, as it may be called, was everywhere found to lie athwart the path of human progress, and the whole upward struggle of rational man, whether physically, socially, or morally, has been with this tyrant of nature, the law of competition. And in so far as he has progressed at all he has done so by gaining, little by little, the mastery in this struggle. In the physical world he has accomplished this through invention from which have resulted the arts. Every utensil of labor, every mechanical device, every object of design, and every artificial form that serves a human purpose, is a triumph of mind over the physical forces of nature in ceaseless and aimless competition. In the social world it is human institutions—religion, government, law, marriage, customs—that have been thought out and adopted to restrain the unbridled individualism that has always menaced society. And finally, the ethical code and the moral law are simply the means employed by reason, intelligence, and refined sensibility to suppress and crush out the animal nature of man.

One important fact has thus far been kept out of view for final treatment in this place. Man, it is true, is a rational being, but he is also still an animal. Notwithstanding the important conquests over nature that have been recounted, he is still very far from being master of the field. The difficulty is that mind itself was developed under the influence of the purely egoistic law. That extraordinary brain development which so exclusively characterizes man was acquired through the primary principle of advantage. Brain does not differ in this respect from horns or teeth or claws. In the great struggle which the human animal went through to gain his supremacy it was brain that finally enabled him to succeed, and under the biologic law of selection, where superior sagacity meant fitness to survive, the human brain was gradually built up, cell upon cell, until the fully developed hemispheres were literally laid over the primary ganglia and the cranial walls enlarged to receive them. The brain of man was thus originally an engine of competition. It was a mere servant of the will. It was only in virtue of its peculiar character by which it was capable of perceiving that the direct animal method was not the most successful one, even in the bare struggle for existence, that it so early began, in the interest of

pure egoism, to antagonize that method and to adopt the opposite indirect method of design, foresight, calculation, and coöperation.

The law of mind, as it operates in society as an aid to competition and in the interest of the individual, is essentially immoral. It rests primarily on the principle of deception. It is an extension to other human beings of the method applied to the animal world by which the latter was subjected to man. This method was that of the ambush and the snare. Its ruling principle was cunning. Its object was to deceive, circumvent, ensnare, and capture. Low animal cunning was succeeded by more refined kinds of cunning. The most important of these go by the names business shrewdness, strategy, and diplomacy, none of which differ from ordinary cunning in anything but the degree of adroitness by which the victim is outwitted. In this way social life is completely honeycombed with deception.

The competition which we see in the social and industrial world—competition aided and modified by reason and intelligence—while it does not differ in either its principle or its purpose from the competition among animals and plants, differs considerably in its methods and in its effects. We see in it the same soulless struggle, the same intense egoism, the same tendency to exaggerate existing inequalities, the same sacrifice of the weaker to the stronger, and the same rage of the latter to possess and monopolize the earth. But, in addition to all this, the opposite principle is also in active operation. This is the law of mind making for a true economy of energy. This economy, however, is a purely individual economy and not a social or political economy. That is, it only benefits the individual, not society nor the state. The effort in each case is solely to benefit self. No account is taken of the benefit or injury of others. Usually the individual knows that it will injure others, and therefore, in order to prevent them from checkmating him, he resorts to one or other of the methods of deception above enumerated. But oftentimes no thought is given to its effect on society, the state, or other individuals.

It has been so strongly maintained that competition results in a real economy that it is worth while to consider this for a moment. The prevailing impression is that if permitted to operate freely it will necessarily keep down prices. There is no greater mistake made by economists. It tends to raise prices to their highest limit.

It does this by the waste it occasions, and the price must be made to cover this waste. In the retail trade of all kinds of commodities the waste is enormous. The number engaged in it is many times greater than is necessary. This is because society has put a stigma upon productive labor and trade is one of the principal ways of living by one's wits. Each seller must devise some means to induce buyers to buy of him instead

of his rivals. One of the principal ways of doing this is that of making his goods known to those likely to want them. From pure inertia they will buy what is brought to them before they will go after it, or they will go to a place they know of rather than hunt another. Hence, every possible means is resorted to by each dealer to advertise his business. Newspaper advertising is the most familiar way, but it is by no means the only one. Costly as it is, it probably costs less than other modes. Among these, display takes a high rank—large French glass show windows illuminated at night even after the hours of closing, with gas or electric lights; add to this the necessity for locating on principal streets and paying high rentals. Posters and running agents, delivery wagons emblazoned with great letters, "opening" invitations sent to thousands, and a variety of other devices, all very expensive, are well known to all. For houses that can afford it all this is supplemented by the traveling salesman or drummer whose ubiquitous presence greets us on every railroad car and at every country hotel. Think of the enormous expense involved in this! There is a latent impression that it is in some way necessary. Yet such is not the case. All these varied modes of making known particular firms and particular goods are wholly unnecessary to society at large. Only so much is wanted and only so much will be bought. If it tends to cause more to be bought than is wanted it does harm. It is only a supposed necessity to each dealer to cause his goods to be bought instead of those of another dealer. But the consumer must pay for all this expensive rivalry. Pass by any first-class restaurant even at the customary hour for meals and you will see perhaps two or three persons eating in a hall that would comfortably seat fifty, in rear of which there will be ten to twenty waiters in dress coats and white gloves waiting for another guest to drop in, if perchance one should. No wonder that at such a place one must pay a dollar for a beefsteak that costs fifteen or twenty cents in the market. It is because the business is so greatly overdone, each competing to attract more than the others. It is the same with the drug business, the cigar business, the confectionery business, and a great number of other businesses.

All these are illustrations of competition under the law of mind. They are the devices of cunning persons to live without work or by some agreeable form of work, and society is regularly called upon to support them by paying in the added prices of all commodities all that the business will bear. This quality of business shrewdness, the modified form of animal cunning, resting primarily upon the principle of deception, is manifest in all forms of advertising. The chief object of an advertisement is to deceive the public and cause the belief that things are better or cheaper than they are. So well is this understood that there is no law to punish the most flagrant falsehood expressed in the

form of an advertisement, and if the dupes and victims of this form of lying remonstrate, that great principle of the common law of England, *caveat emptor*, is laughingly brought forward as the all-sufficient answer.

These illustrations are drawn from one of the few departments in which permanent or at all prolonged competition is possible in society. In nearly all other departments the effect of intelligence is very different. It is mind alone that perceives that competition is wasteful, and therefore, in the interest of the very success that competition seeks, it proceeds to antagonize it and to substitute art, science, and coöperation. By the aid of these the success of those who use them is increased many hundred fold. Competition in society, therefore, tends to defeat itself. It cannot endure. It is at best only a transition stage. On the one hand, the competition between individuals soon takes the form of competition between machines. On the other hand it takes the form of competition between corporations. The former tendency is temporarily injurious but permanently beneficial. The latter is permanently injurious and becomes a serious menace to society. Still it is not an unmixed evil since it prevents the waste of competition. Even the retail industries above referred to are coming within this law. The small houses are being swallowed up by large ones and great universal stores are growing up in all large cities. They result in monopoly but they do not increase prices, and the quality of the goods sold is far more reliable.

The social phenomenon which conforms most nearly to the pattern set in the animal world, and which is most under the influence of the law of nature and least under that of the law of mind, is human labor. Wholly unskilled labor has rarely gone beyond the stage of pure competition. In the olden time skilled labor made a step forward in the formation of guilds, but the era of machinery swept these away. At the time when the founders of the present system of political economy were writing, labor of nearly every kind was almost exclusively competitive. It is only within a few decades that it has begun to fall under the influence of intelligence and to employ the simplest of all rational devices that of coöperation. Capital, on the other hand, being naturally in the hands of the most sagacious members of society, has always combined and coöperated and used all the other arts of overcoming competition. The chief difference between the employers and the employed, until recently, has been that the former have used the rational method, while the latter have used the natural method. But such is the power of the rational method and its superiority over the method of nature that competing labor stood no chance in the struggle with combining capital, and it was possible, to a great extent, to enforce the iron law of wages as formulated by Ricardo. And when, in recent

times, labor at last began in a small way to call to its aid the psychologic economy of coöperation, the step was so unexpected and seemed so strange that it was looked upon as a crime against society, and many still so regard it. Indeed, all the laws of modern nations are framed on the assumption that capital naturally combines, while labor naturally competes, and attempts on the part of labor to combine against capital are usually suppressed by the armed force of the state, while capital is protected by the military and civil authority of the state against such assumed unlawful attempts. This enormous odds against which labor struggles in its efforts to adopt and apply the economics of mind will greatly retard the progress of industrial reform, which aims to place labor on an equal footing with capital in this respect.

The evil that results from the competition of corporations lies in the fact that, as in most competition among rational beings, it is only a brief transition stage to be quickly followed by further combination. Just as competition among individuals results in corporations, so competition between corporations results in combinations of corporations. A common form of these compound corporations is that which is known as a trust. This process of compound coöperation does not stop until all engaged in a given industry are embraced in a single combination and the whole product of that industry is controlled by it. This gives it absolute control over the price of the commodity produced, limited only by the maximum that can be charged without diminishing the profits. Thus, for example, all the petroleum produced by a country may fall under the control of a single trust, and in order to secure for the members of that trust the maximum return for the petroleum, its price will be placed at the highest figures that consumers of petroleum will pay rather than return to candles or resort to gas or electricity. It must not be put so high as to produce a great falling off in the consumption, otherwise there will be a diminution of profits, and this is all that regulates the price. There is no necessary relation between price and cost of production. The price may be twenty or it may be a hundred times the cost. The same is true of coal or iron or sugar or cotton, and even in the case of breadstuffs something analogous can occur through the device which is known as "cornering." All monopolies rest on the same principle and they are as common in the industries of transportation and exchange as in those of production. The railroad, telegraph, and express systems fully illustrate the law, as does also the mercantile business of every country, in all of which competition is short, heated, and fitful, and the result is always the same—the swallowing up of the small industries by the great ones in ever widening cycles.

And thus it comes about that nearly everywhere in human society the law of mind profoundly modifies the phenomena

of industrial life, and produces an entirely different class of results from what would be produced by the operation of the unimpeded law of natural competition. Whether the competition be continued for a time or whether it be converted into a competition of corporations, or whether, finally, it resolve itself into complete monopoly, in any and all cases an enormous artificial difference will be produced between the cost of production and the price to the consumer, and the latter will be pushed up to the maximum limit attainable without affecting profits. In the first case this artificial difference is mostly wasted in aggressive competition, its only benefit to any one being that of doubling or trebling the number of persons who are enabled to live without productive labor. In the other cases and especially in the last, this difference goes to enrich the managers of trusts and to multiply millionaires.

All this is so widely different from what we see everywhere in nature below the level of man's rational faculty, that it requires the application of an entirely different set of principles from those which can be applied to irrational life. There competition is pure. It continues as long as the weaker can survive it, and when these at last go to the wall and the better adapted structures survive and triumph, it is the triumph of physical superiority, and the strong and the robust alone are left to replenish the earth. But when mind enters into the contest all genuine competition is crushed out, and while it is still, in a certain sense, the strong that succeed, it is a strength which comes from superior cunning, necessarily coupled with stunted moral qualities, intense egoism, and undeveloped sympathies, and always aided more or less by the mere accident of position. In no proper sense can it be said that this class is the fittest to survive in society. Considered from this point of view solely, it is evident that brains are a positive detriment to society, and if there were really no hope of discovering and applying a remedy it would doubtless have been better if they had never been developed. It is probably the contemplation of such a hopeless condition that has given rise to the pessimistic philosophy of India and modern Germany.

Free competition as it exists in nature would be preferable to the existing industrial state, and although it is not the boon that many suppose, it is still one of the great desiderata for which society should strive. How can it be secured? Herein lies a great social paradox. It is clear from all that has been said that this will never bring itself about. Competition is growing more and more feeble and ephemeral; combination is growing more and more powerful and permanent. And this is the result of the most complete *laissez faire* policy. The paradox therefore is that *free competition can only be secure through regulation*. The coöperative tendencies of the rule of

mind which destroy competition can only be overcome by that higher form of coöperation which is able to stay the lower form and set the forces of nature free once more.

Let me indulge in a single illustration. Suppose a railroad to be built alongside of an existing canal. Negotiations will be at once begun to purchase the canal, not because it is wanted, but merely to remove it from competition. Such negotiations would be sure to succeed and leave the railroad master of the field. Competition would be removed, rates of transportation increased, and a valuable water way would be abandoned. But suppose society in its collective capacity, however constituted, seeing the situation and the danger, were to step in and itself purchase the canal, and to continue in spite of the railroad to conduct it in the interest of traffic; here would be a case in which the law of mind would be directed to maintaining instead of destroying competition.

Without enlarging further upon this subject, it may be said in defence of competition that a new and revised political economy will devote a large share of its energies to showing, not so much the glories of the competition that now goes on, as how society may conduct itself in order to secure whatever benefits competition can offer. These are considerable, but, as already remarked, they can only be secured through conscious and intelligent social control of those egoistic tendencies which either bring competition to a complete stop and substitute monopoly, or only allow it to go on in such extravagant ways as to be worse than monopoly. Under proper social restraint competition may undoubtedly be retained as an important economic factor. But it would then be divested of its fierce, crushing, and grinding character and reduced to the condition of friendly and healthful emulation which stimulates effort but does not work hardship.

Neither should the influence of the higher attributes of reason and intelligence be discouraged. They are the foundations of civilization and progress. But these, too, should be deprived of their fangs, and made to pursue the paths of peace, justice, and equity. This result, if it is ever attained at all, must be attained by a still higher application of this same law of mind—by the exercise of these higher attributes by society itself. Such a powerful weapon as reason is unsafe in the hands of one individual when wielded against another. It is still more dangerous in the hands of corporations, which proverbially have no souls. It is most baneful of all in the hands of those mighty compound corporations which seek to control the wealth of the world. It is only safe when employed by the social ego, emanating from the collective brain of society, and working for the common interest of the social organism.

But the object of this address was not to point out remedies for social evils. It was, as stated at the outset, to show that any

system of economics which is to deal with rational man must rest upon a psychologic and not upon a biologic basis. It may seem strange, in the light of all that has been said, that there should be any need of calling attention to this truth. And so it would be were it not that, in full view of all these facts, the prevailing system of social economics and social philosophy, completely ignores them and treats the human animal only as an animal.

The old biological economics, culminating in the law of Malthus, has broken down at every point where it has had a fair trial. Its leading tenets have proved false in practice, and in the majority of cases the truth can only be reached by reversing the propositions. It may be profitable to enumerate a few of the economic truths which have been established by the industrial history of the last century and which consist for the most part in the simple negation of the dogmas of political economy as based on the law of nature, unaffected by the law of mind. I will express them in the briefest form without any attempt to elaborate, illustrate, or justify them, this having been done on former occasions¹ or by others, and it is not pretended that the propositions contain anything not already familiar to most economists.

1. Subsistence increases instead of diminishing with population (negation of the dogma of Malthus).

2. Competition usually has the effect to raise prices and rates.

3. Free competition is only possible under social regulation.

4. The evils of private monopoly can only be prevented by a resort to public monopoly.

5. In consequence of ignorance the individual cannot be depended upon to act according to his own interest, and the principle of *caveat emptor* works an unnecessary hardship.

6. The consumer cannot be depended upon to encourage the better producer, and competition results in deterioration.

7. The interest of the individual is rarely the same as that of the community.

8. Market values and social values are not identical, as *e. g.*, those of a forest.

9. In an increasing number of cases the hope of gain is not the best motive to industry.

10. Public service will secure better talent than private enterprise for the same outlay.

11. Private enterprise through aggressive competition and monopoly taxes the people far more heavily than does the state.

12. The prosperity of a community depends as much upon the mode of consumption of wealth as upon the quantity produced.

¹ See especially a paper entitled: "Some Social and Economic Paradoxes," in the *American Anthropologist* for April, 1889, Washington, Vol. II, p. 119.

13. The social effects of taxation are more important than their fiscal effects.

14. The producer cannot always shift the burden of taxation upon the consumer, *e. g.*, under monopoly and aggressive competition.

15. True protection often reduces the price of the commodity protected, sometimes even in the importing country.

16. Capital, as equivalent to machinery, contributes more than labor to the production of wealth.

17. Wages are drawn from products and not from capital, and the "wages-fund" is a myth.

18. Increase of wages is attended with increase of profits.

19. Prices fall as wages rise.

20. Diminished hours of labor bring increased production.

21. Reduction of the time worked enhances the wages received.

The enumeration might be continued to almost any length, but the above will suffice to show that the doctrines of physiocracy, *laissez faire* and Spencerian individualism, and the biologic economy in general, are not sustained, and that the facts which society presents are for the most part the reverse of those which were promised by them. The explanation is that the old political economy is true only of irrational animals and is altogether inapplicable to rational man. Darwin modestly confesses that he derived his original conception of natural selection from the reading of Malthus on population. But he did not perhaps himself perceive that in applying the law of Malthus to the animal world, he was introducing it into the only field in which it holds true. Yet such is the case, and for a reason that has already been given, *viz.*, that the advent with man of the thinking, knowing, foreseeing, calculating, designing, inventing, and constructing faculty, which is wanting in lower creatures, repealed the biologic law or law of nature and enacted in its stead the psychologic law—the law of mind.

January 27, 1893—Ætat. 51.

332. The New Botany

History.—Written Jan. 5-14, 1893. Read before the Biological Society of Washington, Jan. 14, 1893. This article elicited complimentary letters from Charles E. Bessey and David Starr Jordan. The latter was specially pleased with my reference to Professor Campbell. But Professor Libbey, Director of the Princeton Museum, sent me a very sharp rebuke for what I said about the collections there. This was based on a recent visit to Princeton, where I saw the collections and knew whereof I spoke. They were fine, but unnamed, and there were no indications of any intention to study them. *Public Opinion* reprinted more than half of it.

Science, New York, Vol. XXI, No. 521, January 27, 1893, pp. 43-44; *Public Opinion*, Washington and New York, Vol. XIV, No. 20 [Whole No. 358], pp. 474-475.

THIS is an age of new sciences; at least we have a new chemistry, a new astronomy, and a new geology. May we not have a new botany? The real science of botany is what we know of the origin and nature of plants. All other knowledge about plants is preparatory to this. Not only is this true of descriptive botany, which is merely taking off the slabs, as it were, but it is true of structural botany, even where this becomes histological. What has been the object of all the thorough and profound investigations of the German botanists? To show how the existing vegetation has become what it is and how the various kinds of plants are related to one another from the standpoint of real kinship. In a word, it is the development of plant life that constitutes the true science of botany. And think of the enormous labor and research that it has required to arrive at this through the study of the existing plants alone! Whether we consider the working-out of the anatomical structure of all the

various types of vegetation in order to conclude from the different grades of tissue along what lines development has taken place, or whether it be the reproductive organs that engage attention, from the relationships of which the course of botanical evolution may be inferred, the task in either and in any case is immense and has properly engrossed the attention and absorbed the energies of the foremost students of that noble science. And it is proper that the great universities should have prominent chairs of botany to push on the solution of the still unsolved problems of the vegetable world.

But there are two routes that lead to these important results. There are two methods by which the development of plant life may be studied. The one I have outlined is what Huxley has so happily called "the method of Zadig."¹ The past is seen through the present and ancestral forms are inferred from the marks they have stamped upon their posterity. It is a true scientific method, usually the best that nature affords, and it has led us to the greater part of the knowledge we possess with respect to the evolution of world systems, of our own planet's history, and of the development of organic beings.

But far better than this method of "retrospective prophecy" or rational inference, wherever it can be applied, is the method of direct comparison. No one claims that the nature of a form can be reasoned out from no matter how complete a series of facts with the same certainty that it can be learned if it can be actually brought forward for direct observation. Yet this latter is the method of paleontology in all the departments of life to which it can be applied. In the animal kingdom this great resource is freely drawn upon, but in the study of plants it is almost entirely neglected. In all Europe I can only name one chair of botany, that of the University of Strasburg, which is occupied by one who has paid special attention to the paleontological side. In America there is none, and yet we have several able students of botanical evolution from the morphological side, who are doing excellent work. It will not be deemed invidious if I mention the thorough and successful researches of Professor Douglas H. Campbell of the Leland Stanford, Jr., University.

Why have we not equally competent men at work upon the ancient forms? It can no longer be said that the material is wanting. It exists in vast quantities and excellent quality. There have been already collected and not yet at all studied fossil plants enough to furnish employment for a corps of investigators during the balance of the present century. But what exists is nothing to what may be easily obtained. I could direct any one to hundreds of localities where a little labor would certainly be rewarded by abundant results. In nearly all the

¹ Nineteenth Century for June, 1880, vol. vii, p. 929.

geological formations of the United States, from the Devonian to the Pleistocene, there exist rich beds of vegetable remains, as yet only slightly explored, which, if thoroughly developed and studied, would, with scarcely any doubt, throw more light on the evolution of our American floras than any amount of histological investigation of those floras themselves as we now find them could be expected to do.

Without going into details, and omitting entirely the Paleozoic floras, which, as every one knows, are very rich in America and have been chiefly studied, a glance at the Mesozoic and Cenozoic series may be of interest. It begins, so far as we know the plant-bearing horizons, with the Upper Trias, but this, as I have shown,² is found in nine of the States and Territories of the Union, and has already yielded 119 species of fossil plants, sufficient to fix with great accuracy the geological position of the beds and show the general character of the vegetation that flourished on this continent at that remote period. We also know that extensive Permian deposits occur in the West, and there is hope that the interval between these and the plant-bearing Trias may yet be bridged over by the discovery of Lower Triassic forms.

We as yet know nothing of the Jurassic flora of America, unless the Trinity beds of Texas, the supposed Kootanie deposits of Montana, and the lowest Potomac strata of Virginia prove to reach downward into that system. But in these and the great series of clays that overlie them and seem to occupy the entire interval to the Laminated Sands of New Jersey, placed in the Upper Cretaceous, we have an immense period represented by successive plant-bearing horizons, and by scarcely any other remains of life, from which, at this writing, nearly a thousand different plant forms are known, with large collections still awaiting study. If to this we add the great Dakota formation of Kansas and Nebraska, we nearly double these figures, and have a Lower and Middle Cretaceous flora that compares favorably in its number and extent with that of the same areas at the present day.

Between this and the rich Laramie flora of the extreme Upper Cretaceous there is a newly-discovered plant-bearing horizon in the Montana formation, probably the equivalent of the Belly River series of the Canadian geologists, the flora of which is as yet very little known.³ Of the Laramie flora I need scarcely speak⁴ further than to say that all that has thus far been done is

² Bulletin of the Geological Society of America, Proceedings, vol. iii, 1891, pp. 23-31.

³ See the American Journal of Science for April, 1884, 3d Series, vol. xxvii, pp. 292-303.

⁴ See my Synopsis of the Flora of the Laramie Group. Sixth Annual Report of the U. S. Geological Survey, 1884-85, pp. 399-557, pl. xxxi.-lxv.; also, Types of the Laramie Flora. Bulletin of the U. S. Geological Survey, No. 37.

merely preliminary to the elaboration of the extensive collections that I have myself made in this vast store-house of facts bearing upon the history and nature of plant life on this continent.

Overlying the Laramie, or perhaps forming an upper member of it, and occupying wide areas west of the great plains, are other plant-bearing deposits, some of them now known as the Denver formation, others of more doubtful age embracing the Carbon and Evanston coal-fields of Wyoming, others farther north long known as the Fort Union group, and all taken together nearly or quite filling the interval from the recognized Laramie to the Green River group, about whose Tertiary age there has never been any question; and this last itself has entombed along with its beautiful fishes and with insects a great number of vegetable remains in an admirable state of preservation.

In Montana, about the sources of both the Upper Missouri and the Yellowstone Rivers, especially in the Bozeman coal mines and on the flanks of the Amethyst Mountain in the National Yellowstone Park, the series, probably beginning as early as Laramie age, is represented by an almost unbroken succession of plant-yielding deposits, extending upward into the Volcanic Tertiary, where the ruins of vast Sequoian forests mantle the slopes with their erect and prostrate trunks, among whose still persisting roots of stone lie buried in great profusion the more delicate parts, branches, leaves, fruits, and even flowers, of a rich and varied flora. Thousands of beautifully preserved impressions of these have been collected by Professor Knowlton and myself in two field seasons' operations, besides a most extensive series of the silicified wood, showing its internal structure as perfectly as if it were still living.

On the other side of the great continental divide, in California, Oregon, and Washington, there are Miocene and still later deposits, in which have been found the later floras of the continent, but whose extent can as yet only be conjectured. Even in Alaska there are great areas which have only to be scratched to make them tell of oaks and willows and a great number of vegetable forms that flourished there in late Tertiary time, the analogues of which are now only found in the latitude of the States and along the Atlantic border.

Is it possible that botanists care nothing for all this? Do they prefer to drudge upon the tissues of living plants to learn what may be known by actually confronting the witnesses themselves of the real character of the ancient vegetation of the earth and the true lines along which it has developed? It cannot be. And yet such would be the logic of their action. The truth is that institutions of learning, much like the masses of mankind, are the votaries of fashion. It is fashionable to found chairs of structural and physiological botany, and it is fashionable to occupy them and work out refined problems in the niceties of the science. Would

there were no worse fashions! "These ought ye to have done and not to leave the other undone." The government has led the way, through its several geological surveys, in establishing the existence of these inexhaustible sources of botanical knowledge, but it cannot, and probably should not, sustain the careful and prolonged researches necessary to the solution of the many and important scientific problems that naturally grow out of such a mass of information. It can only use the data thus accumulated in the settlement of the geological questions involved, and in the development of the economic resources of the country to which they serve as aids. The purely scientific results belong to the higher institutions of learning to work out. It is true that only the great and well-endowed ones can conveniently undertake this work, but these are in condition to do so, and there is nothing that could reflect greater credit upon an American university. Such institutions make themselves a history by the original research they foster and not by their pedagogic achievements. A proper amount of teaching in the form of lectures growing out of laboratory work is useful to give precision to such work as well as to instruct, but it should never engross the energy of the teacher to the exclusion of the chief object, the advancement of science. In this case the materials are bulky and their collection and transportation expensive, yet several leading American colleges have frequently indulged in this part of the expense, and then, strangely enough, stopped there, and stored their cellars with undetermined material; or, if they have gone further, as at Princeton, and been to the expense of installing the specimens in their museums and employing a curator to take charge of them, they only cumber their shelves with unnamed and unknown objects, to be looked at as mere curiosities.

To set forth any detailed plan for putting these suggestions into practice would unduly prolong this article, but surely no one will claim that the prosecution of paleobotanical research is impracticable in a country that boasts of such universities as those at Chicago and at Palo Alto. All that is needed is that its importance be recognized; the task of reducing it to practice is only a matter of administration. The difficulty is to persuade educators to look to value instead of custom in the encouragement of research. The great energy that is devoted to small things is only less strange than the little energy that is devoted to great things, and a new and advanced spirit needs to be breathed into our higher education.

The new botany is not merely the study of plants from the paleontological side; it is their study from all sides and from all points of view, and a school of botany in a great modern university should no more limit itself to the facts that living plants present than a school of history should be narrowed down to the old method of recounting the deeds of kings, dynasties, and

warriors, as constituting all of human history. The mere "determination" of fossil plants, although of course the most laborious part, is a comparatively unimportant part from the botanical standpoint. The great work is their affiliation. As I have shown, we have in America a succession of plant-bearing horizons not so widely separated in time but that the later forms may be in large degree affiliated upon the next earlier ones so that, in the right hands, there is hope that something like a complete history of plant development may be ultimately worked out. No grander theme presents itself to the scientific world, and the time is ripe for its inauguration. Hitherto the study of fossil plants has been conducted wholly from the geological standpoint, and, as I have been obliged to insist,¹ this does not necessarily involve the correct systematic determination of fossil forms, provided their identity can be surely recognized wherever found. A new method is therefore loudly called for, by which far greater certainty than heretofore can be reached in establishing the real nature and affinities of extinct floras. In other words, they must be studied from the botanical standpoint and all the light brought to bear upon them that the known flora of the whole globe is able to shed. This is no simple task, it is one that demands the highest ability and the widest facilities. But thus pursued, with sufficient time, patience, and labor, its success is certain, and its value beyond calculation.

¹ American Geologist, vol. ix, January, 1892, pp. 39-40.

March 27, 1893—Ætat. 51.

333. [Dr. Newberry's Work in Paleobotany]

History.—Written the early part of February, 1893, and sent to Prof. H. L. Fairchild, who incorporated it into his Biographical sketch of Dr. Newberry.

Transactions of the New York Academy of Sciences, New York, Vol. XII, October, 1892, to June 1893, March 27, 1893, pp. 162-163; Reprint: A Memoir of Professor John Strong Newberry, by Herman LeRoy Fairchild.—Bibliography of Professor Newberry, by James F. Kemp. New York, 1893, pp. 162-163.

DR. NEWBERRY was a great geologist, without which qualification no one can appreciate the full significance of fossil plants. He never spoke of them without evincing a lively consciousness that they were once real and living plants, and that they belonged to the great record which time has made of the events which have transpired in the history of the earth. It was this constant realization of the objective truth which geology unfolds, a state of mind apparently wanting in the majority of geologists and paleontologists, that gave Dr. Newberry's utterances their chief weight, as well as their peculiar charm.

Dr. Newberry was not a good botanist. He had once been, but had neglected to keep pace with the science. Moreover, he seemed to have very little interest in the more important principles of botany. He was utterly indifferent to questions of classification, and to judge from his published papers one order of arrangement was as good for him as another. This was not from lack of knowledge, except so far as indifference checked the effort to know, and he was not wholly indifferent to the order of development of plant life, as his article on *Fossil Botany* in Johnson's *Cyclopedia* shows, although at the time that was written the true order had not yet been established as it is understood to-day, and his admissions of the apparent failure of

plants to sustain the general law of development might have then been justified.

Of Dr. Newberry's early pioneer work on the Carboniferous flora of America, I do not profess to be a competent judge, but I believe it was as good as could have been done at that time. His determinations of the later forms have not all stood the test of time, but the same can be said of every worker in this field. He was no species-monger, and not prone to found species on insufficient material. His descriptions were all governed by strong common sense, and, unlike many other paleobotanists, he never forgot that he was dealing with real things. His discussions therefore, of doubtful or unknown forms were always directed to ascertaining what they really were and not merely to deciding what they should be called.

April 28, 1893—Ætat. 51.

334. The Political Ethics of Herbert Spencer.—Abstract

History.—This brief abstract was written at the request of the Secretary for the minutes of the meeting. The Secretary must have given a copy of it to the press, as it appeared in the *Public Ledger* the next morning.

Annals of the American Academy of Political and Social Science, Philadelphia, Vol. IV, No. 1, July, 1893, pp. 151-152; Public Ledger, Philadelphia, April 28, 1893, p. 14.

THE speaker criticised the rank which Mr. Spencer gives to ethics in his scheme of philosophy.

"He has made it," he said, "the great end of all his labors, while from the very character of his 'ethics,' the doctrine that happiness is the end of action, and the argument that this will ultimately be attained through altruistic action, becoming that which yields the greatest happiness—the most egoistic—it is evident that 'ethics' relates to a theoretically transient state of society, which is to pass away as soon as altruistic and egoistic actions shall have become mutually adjusted. 'Ethics,' therefore, during this transition period, is merely a department of sociology, and only entitled to a subordinate place in the sociological scheme.

"The fundamental principle which seems to underlie every statement of Mr. Spencer's works is that of self-adjustment. To his mind the arch offender against the laws of nature is Government. He can see no bond of mutuality between the Government and the citizen. With him the former is an outside power, working against the latter and for itself alone."

After having taken up various opinions set forth in Mr. Spencer's works, Professor Ward observed that, in comparing his later with his earlier writings, there was evidently a gradual dying out of his warmer and more sympathetic impulses, which, at the beginning of his career, made him the friend of all who suffered from the effects of an imperfect social state.

"It is simply astonishing," said the speaker, "that the great exponent of the law of evolution in all other departments should so signally fail to grasp that law in this highest department. The extreme *noli tangere* individualism with which the entire social philosophy of Herbert Spencer is permeated must, in spite of all disclaimers, impart to it the character of a gospel of nihilism."

May, 1893—Ætat. 51.

335. Notice of Flora Tertiaria Italica, Auctoribus A. Meschinelli and X. Squinabol. 1 Vol. 8°, pp. lxii+578. Patavii, 1893

History.—Written March 17, 1893.

The American Journal of Science, New Haven, Third Series, Vol. XLV [Whole Number CXLV], No. 269, May, 1893, pp. 438-439.

May, 1893—Ætat. 51.

336. Notice of Additions to the Paleobotany of the Cretaceous Formation on Staten Island; by Arthur Hollick. Trans. N. Y. Acad. Sci., Vol. XII., pp. 1-12, pl. i-iv

History.—Written March 20, 1893.

Ibid., p. 437.

May, 1893—Ætat. 51.

337. Notice of Fossil Plants as Tests of Climate; by A. C. Seward. xii+151 pp., 8°. London, 1892

History.—Written March 21, 1893.

Ibid., p. 438.

May, 1893—Ætat. 51.

338. Notice of a memoir On the Organization of the Fossil Plants of the Coal Measures, Part XIX; by W. C. Williamson. Phil. Trans. Roy. Soc. London, Vol. CXXXIV, B, 1893, pp. 1-38, pl. i-ix

History.—Written March 23, 1893.

Ibid., pp. 437-438.

May, 1893—Ætat. 51.

339. Notice of the Correlation of Early Cretaceous Floras in Canada and the United States; by Sir J. W. Dawson. Trans. Roy. Soc. Canada, Section IV, Vol. X, pp. 79-93

History.—Written March 27, 1893.

Ibid., p. 439.

May, 1893—Ætat. 51.

340. Notice of a New Tæniopterid Fern
and its Allies; by David White. Bulletin Geol. Soc. of America, Vol. IV, pp.
119-132, pl. i

History.—Written April 3, 1893.

Ibid., pp. 439-440.

May, 1893—Ætat. 51.

341. [Resolutions on the Death of Dr.
George Vasey]

History.—Written March 6, 1893. Dr. George Vasey, Botanist of the Department of Agriculture since 1872, and with whom I was closely associated during all that time, died on March 4, 1893. On March 6, Prof. G. Brown Goode, Director of the U. S. National Museum in which the National Herbarium of which Dr. Vasey had charge, was then located, notified Dr. F. H. Knowlton and me that there would be a meeting in his office at noon to take action with regard to the matter, and requested us to draft some suitable resolutions to be read at that meeting. I knew that we did so, but I had labored under the impression that Dr. Knowlton did most of the work, until recently I discovered among my papers the draft of the resolutions, substantially as printed, in my handwriting. A *Biographical Sketch* of Dr. Vasey was subsequently prepared by Messrs. Wm. M. Canby and Joseph N. Rose, in which these resolutions were published. After appearing in the *Botanical Gazette* the sketch

was issued in pamphlet form, and I received a copy from Mrs. Vasey in June. The sketch contains an excellent portrait.

The Botanical Gazette, Bloomington, Indiana, Vol. XVIII, No. 5, May, 1893, p. 176. In: *George Vasey: A Biographical Sketch*, by William M. Canby, Wilmington, Delaware, and Joseph N. Rose, Department of Agriculture, Washington, D. C., p. 176.

IN the death of Dr. George Vasey the National Museum has lost a faithful and efficient officer, and the science of botany an able and indefatigable worker. As botanist of the Department of Agriculture and curator of the National Herbarium for twenty-one years, Dr. Vasey's name has become known to all botanists throughout the world and his contributions to science form an indispensable part of the working library of every botanist. His familiarity with the flora of all parts of the United States, especially with the plants of the great west, was unrivaled and caused his opinion to be sought and respected upon all critical questions relating thereto. He was the recognized authority on this side of the Atlantic in the important department of grasses, and his publications relating to these have great economic as well as scientific value.

Dr. Vasey was uniformly gentle and kind, manifesting a warm interest in the progress of younger botanists and beginners, always ready to give his valuable time and counsels to those who went to him for assistance, and many who are now well known in the science owe their success in large part to the encouragement and stimulation received from him. In this way the circle of his influence was much wider than would be naturally inferred from his quiet life and long confinement to a single post of duty.

To the world at large Dr. Vasey was distinguished for his modest and unobtrusive character, his kindly disposition, and his genial manners. A model husband and father, an estimable neighbor and a good citizen, his loss will be deeply felt by all who knew him. Therefore,

Resolved, That the sympathies of the officers of the National Museum and Smithsonian Institution be extended to the widow and family of the deceased, and that a copy of this minute and resolution be transmitted to them.

May, 1893—Ætat. 51.

342. Frost Freaks of the Dittany

History.—Written Dec. 8–10, 1892. I made the sketches and they were drawn by my draftsman. On the 17, I read the paper before the Biological Society of Washington. I had made an image of the phenomenon, consisting of the split stem of one of the plants with white paper sewed to it and rolled into a scroll to imitate the scrolls of ice and this I exhibited to the Society. Mr. Mason, who was with me when we found the frost freaks, placed an enlarged figure of them on the black-board. Mr. Mason took part in the discussion, which was very animated, the object arousing great curiosity. I sent the paper and drawings to Mr. John M. Coulter, editor of the *Botanical Gazette*, on the 19. He referred them to Prof. J. C. Arthur who wrote me on Feb. 1, 1893, referring me to the similar behavior of *Helianthemum Canadense*, as mentioned in Gray's *Manual* and in Gibson's *Sharp Eyes*. I found the latter work in the Library of Congress and added a paragraph to my manuscript, viz., that on pp. 185–186, which I sent to Professor Arthur.

As predicted at the end of the article, evidence of the earlier discovery of this phenomenon and of its occurrence in other plants soon reached me, and considerable literature grew out of it.

Ibid., pp. 183–186, pl. xix.

June 6, 1893—Ætat. 51.

343. [Preliminary Announcement of The Psychic Factors of Civilization]

History.—Written Feb. 6, 1893. The manuscript of my second book, *The Psychic Factors of Civilization*, was sent to the publishers on Jan. 16, 1893, and soon after they requested me to send them a preliminary announcement of it. I wrote this and sent it on Feb. 15, but they did not print it till May or June. I sent them a large list of addresses to send announcements to. On June 6, they sent me several hundred of these circulars and I distributed them all myself.

THE PSYCHIC FACTORS OF CIVILIZATION. BY LESTER
F. WARD, *Author of Dynamic Sociology.*

Ready in July.

This book is a new presentation of the whole subject of social progress, past, present, and future, written from a scientific standpoint, but in a popular style, and carrying the reader from the most fundamental principles up to their application to the living issues of the times. It breathes a thoroughly liberal, progressive, and American spirit, and cannot fail to be of great interest to all who wish to be acquainted with the advanced thought of the age.

GINN & COMPANY, Publishers.

July 30, 1893—Ætat. 52.

344. [Note on the Fossil Cycads from South Dakota]

History.—Written June 14-15, 1893. On March 22, 1893, a beautiful specimen of a fossil cycadean trunk was received at the U. S. National Museum from a man named Cole in South Dakota, who wrote that he had five others and desired to sell them to the Government at \$20 each. I was consulted in the matter and advised that \$100 be offered for the lot of six. This was done and the offer accepted. It was the beginning of my work on the cycads of the Black Hills. This note was written at the request of Mr. Winlock in the Secretary's office, and was intended for insertion in the *Washington Post*. I sent it to Mr. Winlock and it appeared in *Science*. I do not know whether or not it also appeared in the *Post*.

Science, New York, Vol. XXI, No. 543, June 30, 1893, p. 355.

July, 1893—Ætat. 52.

345. [The Social Effects of Taxation]

History.—Remarks on the paper entitled: *A New Canon of Taxation*, by Dr. Edward A. Ross, read Aug. 24, 1892. The *Proceedings* were not issued till sometime in July, 1893.

Report of the Proceedings of the American Economic Association at the Fifth Annual Meeting, Chautauqua, N. Y., Aug. 23-26, 1892. Publications of the Am. Econ. Assoc., Vol. VIII, No. 1, January, 1893, pp. 50-51.

September 29, 1893—Ætat. 52.

346. [Second Announcement of The Psychic Factors of Civilization]

History.—Written Aug. 2, 1893. This was asked for on that date to be printed on 7,000 postal cards which they had addressed to people whose names I had sent them. On Sept. 29, I received a large number of these postal cards which I distributed. The publishers distributed the greater number. They placed at the head of it an extract from a letter that Dr. Ross had written to them. It was in these words: "I have the highest opinion of its merit and value. It is a profound and original book that touches matters of earnest discussion at the present time."

THE PSYCHIC FACTORS OF CIVILIZATION. BY LESTER
F. WARD, Author of "*Dynamic Sociology*."

Octavo. Cloth. xxi+369 pages. By mail, postpaid, \$2.00.

This work, like its predecessor, *Dynamic Sociology*, makes a bold advance into philosophy. It is not too much to say that it deals with the most important questions before the world and brings out some startling results. It shows that, notwithstanding the amount of attention that has been devoted to mind, the leading truths connected with its origin and development have been overlooked. It also shows that the true influence of mind in human history and civilization is little understood, and that its existence as a factor in political economy and social science has been deliberately ignored. The object of the book is to prepare the way for a *social science based on mind*, and to foreshadow a new political economy that shall recognize man as a rational being. In a word, it is a powerful protest against the sterile philosophy and dismal economics that have so long prevailed, and is itself a philosophy of hope based on faith in the efficacy of rational scientific action.

The work is embellished with a fine array of quotations, mottoes, and literary gems, so that it is almost an anthology of the subject. It is also provided with an annotated list of authors and titles, and a copious index.

GINN & COMPANY, Publishers,
Boston, New York & Chicago.

October, 1893—Ætat. 52.

347. [Letters Relating to the Genus Winchellia]

History.—These letters explain themselves and give the full history of the subject, but as they would be wholly meaningless without the descriptions and figures, I conclude to reproduce the article entire from the *Geologist*, including Professor Winchell's notes. Professor Winchell returned to me the manuscript and drawings of Professor Lesquereux with the proof, and in returning the latter I failed to return the former. As they formed no part of my official work for the U. S. Geological Survey, I placed them in a large envelope and put them in a drawer of odds and ends. There they lay for years, and when I left Washington I somewhat inadvertently brought them away along with other unofficial matters. I find them among my own manuscripts, and as they never have been and probably never will be called for, I am using them as the copy for this article.

The American Geologist, Minneapolis, Vol. XII, No. 4, October, 1893, pp. 209-213, pl. viii, ix.

October, 5, 1893—Ætat. 52.

348. Weismann's Theory of Heredity*

History.—Written Sept. 23–24, 1893. I received a copy of Weismann's *Germ-Plasm* from Mr. Aydelotte for review in *Public Opinion* March 2, 1893, and commenced reading it almost immediately, but made slow progress and did not finish it till Sept. 13, the same day that I returned from the Black Hills. I had the book with me but got little chance to read except on the train. That was an exceedingly busy summer for me, my *Psychic Factors of Civilization* passing through the press, several lectures and addresses to write and deliver, besides the World's Fair at Chicago with all its demands and distractions. After reading the book I prepared slip notes from which to write the review, which required much more time than the mere writing of it.

Public Opinion, Washington and New York, Vol. XVI, No. 27 [Whole No. 391]
October 5, 1893, pp. 11–12

THIS book is an attempt to write a popular treatise on a very technical subject, but one which is at the same time of great popular interest. As a popular treatise it is not successful, being far too difficult reading for the great majority of non-specialists. Indeed, it is very hard reading for specialists, except perhaps for embryologists. The difficulty is, of course, largely in the subject, but it is also to a great extent in the mode of presentation. Weismann's full theory of heredity is too new to himself for him to state it in a consistent and systematic form. The greatest

* *The Germ-Plasm: A Theory of Heredity*. By August Weismann. Translated by W. Newton Parker and Harriet Rönnefeldt. New York: Charles Scribner's Sons. 1893.

lack is that of definition. His terms are nearly all new, and one finds no one place where they are fully and clearly defined. They are brought into the work at its several stages, often used before they are defined at all, partially explained in one place and then further developed under several subsequent heads. The reader is impressed with the idea that the whole theory was in process of growth in the author's mind as he advanced with the work. His lack of acquaintance, until quite recently, with such writers as Herbert Spencer and Francis Galton shows how new is his whole conception of a general philosophic treatment of heredity, although it has certainly been many years since he himself began the study of such questions.

What, then, is his theory? Can it be reduced to any simple form of statement? No doubt it could be by any one having a complete grasp of it, but few can probably gain such a grasp by reading this book. Any attempt at a statement of it would therefore probably fall short, and contain what he would consider mistakes. This, however, would doubtless be to a greater or less extent chargeable to the book itself.

The entire theory hangs on the nature of the "primary constituents" of the germ-plasm. The term "primary constituents," for which the German word appears always to be *Anlage*, seems to be (although he nowhere says so) the generic term, embracing any and all of the several grades of hereditary units of which the germ-plasm is composed. Ignoring the lower stages, it is known that the young of all creatures are developed from a fertilized cell. This development of the germ-cell into a new being resembling its parents is called *ontogeny*. All true cells possess a nucleus, and the germ-plasm constitutes a portion of the nucleus of the germ-cell. The germ-cell and its nucleus are visible objects and embryologists have long been at work with the microscope in actually watching the first stages of ontogeny. All the steps, from the moment of fertilization to the formation of a nuclear spindle or *centrosome* with the peculiar thread-like rods called *chromosomes* derived from the two parents and persistently kept separate and arranged upon it, had been repeatedly observed. The peculiar behavior of these nuclear rods at these and subsequent stages led to the belief that they constitute the essential hereditary substance which finally blends in the formation of the embryo.

Such is the basis of observed fact upon which the theory of heredity rests. The subsequent stages belong to embryology. The problem is to arrive at the antecedent stages. The chromosomes are the smallest objects that can be detected by the microscope, but many facts, not to speak of the unavoidable deduction from general principles, indicate that they are highly complex bodies. To begin with, they are proved to be longitudinally double, from which it is believed that animals derive

their bilateral symmetry. But they must also be otherwise compound, and contain within themselves a vast multitude of special attributes, out of which the numerous parts of the future organism are to be formed. All the ancestral characters that both parents have contributed to the germ are locked up in these minute loops of protoplasm. On Weismann's theory every character that is to appear in the progeny must be produced by a separate and distinct hereditary unit. In a former essay he has carefully worked out the process by which these elements are introduced through sexual reproduction or the more generalized process which he calls *amphimixis*. As each parent contributes all its characters with each union these soon come to be innumerable, and when the maximum number is reached that the germ can contain there occurs at two of the ontogenetic stages a "reducing division," by which half the hereditary units are rejected. Weismann has introduced the term *id* for these ancestral plasms or individualities, deriving it from the "idioplasm" of Nägeli, and for the rods, threads, loops, etc., which they compose, and which, from the fortunate circumstance that they readily absorb the coloring matter used in studying the germ so as to make them visible, were formerly called *chromatosomes*, he proposes the name of *idants*.

The difficult problem is to account for the selection from among the great number of *ids* that are left after both reducing divisions of the particular ones that are to continue active and determine the form that the new being is to assume. Manifestly a large part of them, the older and ancestral types, must become latent and take no part in the process. Galton saw this clearly and attempted to account for it. But for it reversion and atavism, instead of being of rare occurrence, would be universal, and there would be no certainty that children would resemble their parents at all. Weismann's first assumption, therefore, is that the *ids* are composed of units of a lower order, which he calls the *determinants*, and that their action, like that of democratic states, is governed by a sort of majority rule among the determinants. The effect of the reducing divisions, by perpetually halving the ancestral plasms, is to keep them constantly in the minority, so that only by a combination of rare coincidences can they gain the mastery and cause a reappearance of antiquated characters. The determinants themselves are also composite bodies and are made up of the primary elements of life. These primordial vital units play the same rôle in Weismann's theory as do the *gemmules* of Darwin's pangenesis, the "physiological units" of Herbert Spencer, or the *plastidules* of Haeckel. They have been assumed by nearly every author of theories of heredity, and go by many other names, such as *plasome* (Brücke), *micella* (Nägeli), *pangene* (De Vries), etc., although each author ascribes to them somewhat different

properties. Weismann prefers to call them *biophors*, or bearers of vitality. With him they differ in all degrees from one another and possess all the individuality of the determinants and ids.

At the close of the first stages of ontogeny, as is well known, the centrosomes and idants break up, dissolve and disappear, and even the nucleus of the germ-cell seems to have been absorbed, giving to the interior of the cell for a time the appearance of complete homogeneity. This Weismann, accepting the notion of De Vries, attributes to the disbanding not only of the ids, but of the determinants and the resolution of the entire germ-plasm into its primordial elements, the biophors, which, from their minute size, are capable of penetrating the nuclear integument and migrating into the general cell-body, still endowed with their determining powers, and instructed, as it were, to form just such an embryo, which can develop into no other being than the one decided upon in the struggle of the ids during the first stages of ontogeny.

Such are the barest outlines of a theory which must seem to many exceedingly mechanical and rigid, and which a careful reading of the book is likely to give a still stiffer appearance. Still it cannot be denied that many of even the most improbable appearing features are sustained by facts which seem incapable of any other interpretation.

The translators have done their best, and the English is much better than that of his *Essays*. Especially satisfactory are the numerous German words inserted in parenthesis as an aid to the reader. They shed an additional light on the thought, even in cases where no better rendering can be suggested than the one given. A German edition has recently appeared, but the English translation antedated it by several months, and must have been made from the original manuscript.

